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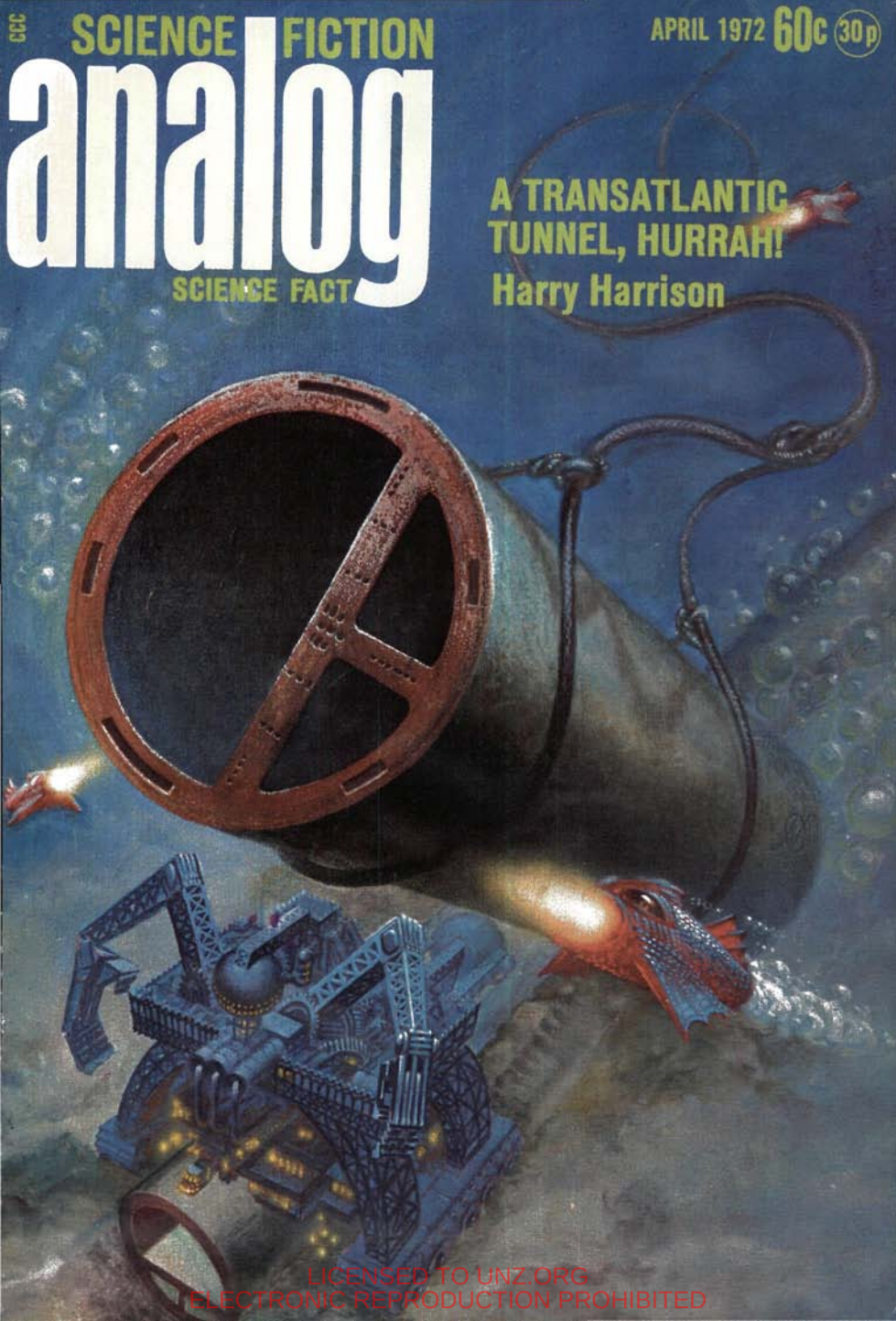
APRIL 1972 60c (30p)

A TRANSATLANTIC TUNNEL, HURRAH!

Harry Harrison



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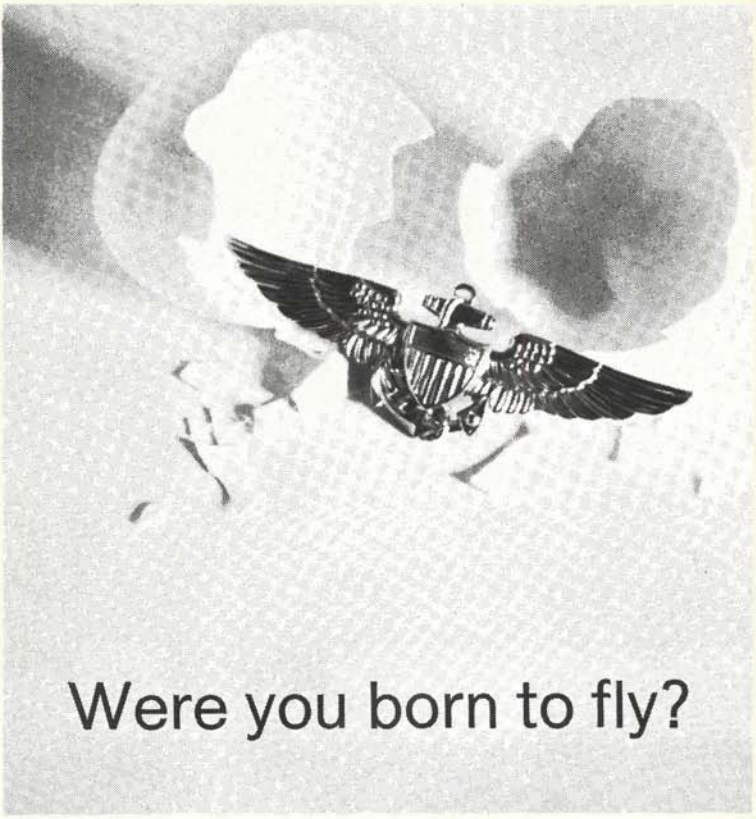

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Next Issue On Sale April 6, 1972
$6.00 per year in the U.S.A.
60 cents per copy
Cover by Kelly Freas

Vol. LXXXIX, No. 2 / April 1972

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tion/Science Fact is published monthly by The Condé Nast Publications, Inc., 420 Lexington Avenue, New York, N. Y. 10017. Perry L. Ruston, President; Fred C. Thormann, Treasurer; Mary E. Campbell, Secretary. Second class postage paid at New York, N. Y. and at additional mailing offices. Subscriptions: in U.S., possessions and Canada, $6 for one year, $10 for two years, $13 for three years. Elsewhere, $8 for one year, $16 for two years. Payable in advance. Single copies in U.S. possessions and Canada, 60¢. For subscriptions, address changes and adjustments, write to Analog Science Fiction/Science Fact, Box 5205, Boulder, Colorado 80302. Six weeks are required for change of address. The editorial contents have not been published before, are protected by copyright and cannot be reprinted without the publisher's permission. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. We cannot accept responsibility for unsolicited manuscripts or art work. Any material submitted must include return postage.

POSTMASTER: SEND FORM 3579 to ANALOG SCIENCE FICTION/SCIENCE FACT, BOX 5205, BOULDER, COLORADO 80302

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ffices: 420 Lexington
venue, New York, N. Y
0017.
ubscriptions: Analog
cience Fiction/Science
act, Box 5205, Boulder
olorado 80302

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"what good is it?"

an editorial by BEN BOVA

On the weekend that Mariner 9 went into orbit around Mars, I received a call from the New York office of the British Broadcasting Company. A pleasant-voiced young woman asked if the editor of Analog would be willing to make some comments, *via* transoceanic telephone, about the Mars flight for a BBC radio show.

"What we want is something wild and far-out . . . you know, something science-fictional, sort of crazy."

The interview never took place.

But the incident stirred all sorts of memories. Here was a perfectly respectable radio journalist sitting in London, ready to talk to New York over a communications link that included an artificial satellite relay, about a spacecraft that had just gone into orbit around Mars. And she wanted something way-out!

It's symptomatic of what's happened to the Exploration of Space. There's no more sense of wonder about it; it's getting to be almost commonplace. In fact, the BBC show was scrubbed at the last minute because the President of the United States announced further troop withdrawals from Vietnam. That took precedence over Mars. And isn't *that* symptomatic of what's happened to the space program!

Back in those ancient days when Arthur Clarke had written only two or three books, and Wernher von Braun was still top-secret, those of us who spoke in public gatherings about going to the Moon or Mars were usually greeted with pained stares, distasteful grimaces, and two words:

"It's impossible."

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A few years later, when von Braun was launching Explorer I into the wake of two stunning Russian successes and the wreckage of Vanguard, people still thought that going to the Moon was ridiculous. But now they no longer claimed it to be impossible. Said they:

"It's too expensive."

By July of 1969, when Yankee ingenuity—and a Boston Irish President's leadership—had put Americans on the Moon, the popular song was:

"We knew it all along."

An interesting evolution of attitudes: It's impossible. It's too expensive. We knew it all along.

Lately, a new verse has been added to the old refrain:

"What good is it?"

Space exploration is not Relevant. It does not attack the Burning Issues of Our Times. It's a needless luxury. What's it done for the average man?

If you accept the context in which those accusations are usually made, all of the charges are true. Space exploration is no more relevant to our pressing social problems than Columbus's voyages were to the battle between Christianity and Islam on the Iberian peninsula. The fact that Europe became absolutely undisputed master of the world, eclipsing the Muslims, Indians, Turks, Chinese, and everybody else—well, was that cause or effect? Hard to say; but the fact is that the two events went hand-in-hand: exploration and a critical change in the tide of world history went together.

Is it any coincidence that our thrust into space exploration came at a time when we, as a nation, were determined to prove to the world that our technology was second to none? Is it a coincidence that our international prestige was enormously—if temporarily—uplifted by the success of Apollo 11? Or that our prestige has been slumping hand-in-hand with our decreasing vitality in space exploration?

But—what good is it?

Most of us who enjoy science fiction have the feeling that space exploration is a fundamental, vital part of mankind's growth. In a sense, this is an almost religious feeling: man *must* explore space, because, well, that's what being a human being is all about! Fine. This feeling—like all religious fervors—is well and good for the believers. But it doesn't convince the infidels. And there are a lot more of *them* than there are of *us*.

The anti-intellectual streak in America is wide and deep. You can see it in the attitudes that the average

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American has toward university professors and "them college kids." You can see it in the hallowed chambers of Congress, where science is treated as something sort of in-between a pork barrel and a cure-all. You can see it in the political leaders we elect: "eggheads" don't make it, "the average man" does. From the self-professed know-nothings of the last century to the McCarthy purges of the 1950s, anti-intellectualism has consistently been a powerful force in American politics.

The current attack on the space program is only a small part of a general attack on science and technology, an attack that draws its strength from this basic anti-intellectual attitude. The scientist is a figure of mystery and fear to many Americans. Just take a look at the way scientists are portrayed in most theatrical or film productions: either the scientist is cold, ruthless and amoral, or he's a ridiculous, pompous ass who can't see an inch past his own nose.

So, if we try to answer the "What good is it?" question by saying that space exploration is necessary to further man's development, to increase our knowledge of the universe, to look for other forms of life, perhaps other intelligent races—*forget it!* That kind of argument will not only fail to win supporters for space exploration, it will actually frighten many people at the deepest levels of their consciousness.

The question of the value of our exploration of space is really a subunit of the larger issue: What good is this mighty technology we have developed?

There are many people in this fair land who seriously believe that technology is a threat to human existence. They equate war, pollution, overpopulation, and the tensions and anxieties of urban life with the rise of technology. And since technology is evil, in this view, then science must be evil, too.

How can this attitude be changed? Only by performance. Only by answering that simple, tough question: What good is it?

The problem is, technology *by itself* can't solve the problems that are bothering most Americans today.

Getting to the Moon was a relatively easy job. There was a basic political decision to be made. Once made, the scientists and engineers had a clear field ahead of them. Politicians battled each other for the chance to get NASA centers—and jobs—in their states. Congress voted the billions of dollars necessary to get the job done, mainly because international politics made Project Apollo an important display of American strength and determination.

But look at the problems that are relevant today. Urban decay. Intercity transportation. Education. Pollution. Clearly, technology has an important role to play in the solution of each of these problems. But just as

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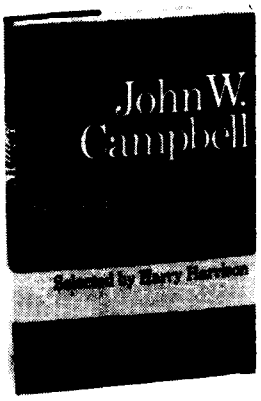

clearly, the political and social aspects of these problems loom much larger than the technological aspect.

Shortly before Albert Einstein died, a disillusioned young man asked him, "How come we can make nuclear bombs, but we can't make peace?" Einstein replied, "Because nuclear physics is much simpler than politics." True enough. Hit a uranium atom's nucleus with a proton of sufficient energy, and the nucleus will fission. Every time. Hit a man with a new idea and you have very little idea of what he'll do. People are unpredictable, despite the best efforts so far of the sociologists and psychologists.

Going to the Moon was easy compared to building a highway through a city. The Moon isn't cluttered up with unpredictable people who don't want to move out of the way, who refuse to be steamrollered, who'll tie you up in court for years of costly delays.

The aerospace industry is aching to turn its talents and unemployed manpower loose on transportation and pollution problems. But the political structure to support such technology simply does not exist. Not yet. There is no way for a Boeing or Grumman to tackle, say, the air pollution problem of New York City. The *technology* exists. Using technology on hand today, and a clear political field, the engineers could reduce air pollution levels enormously.

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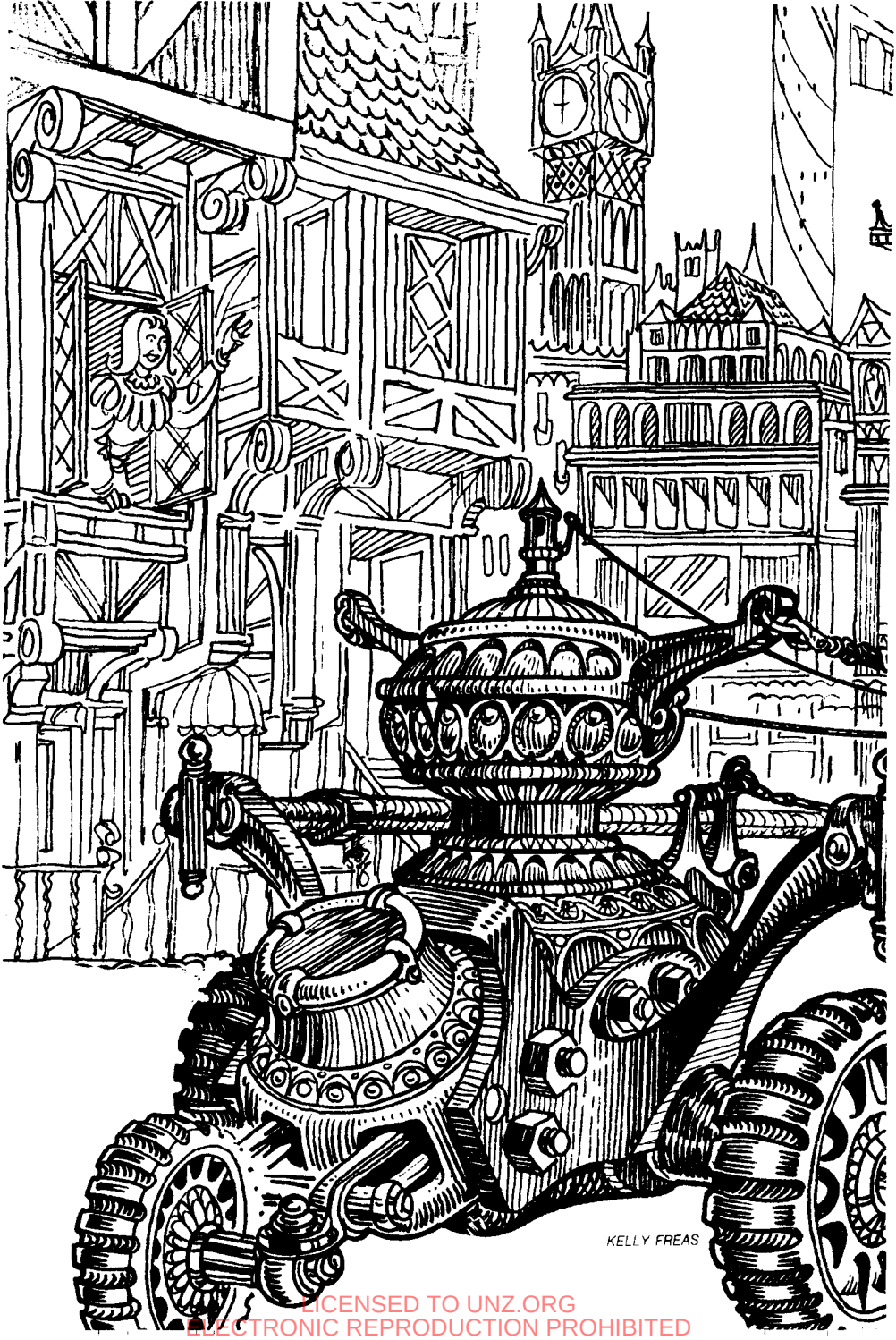

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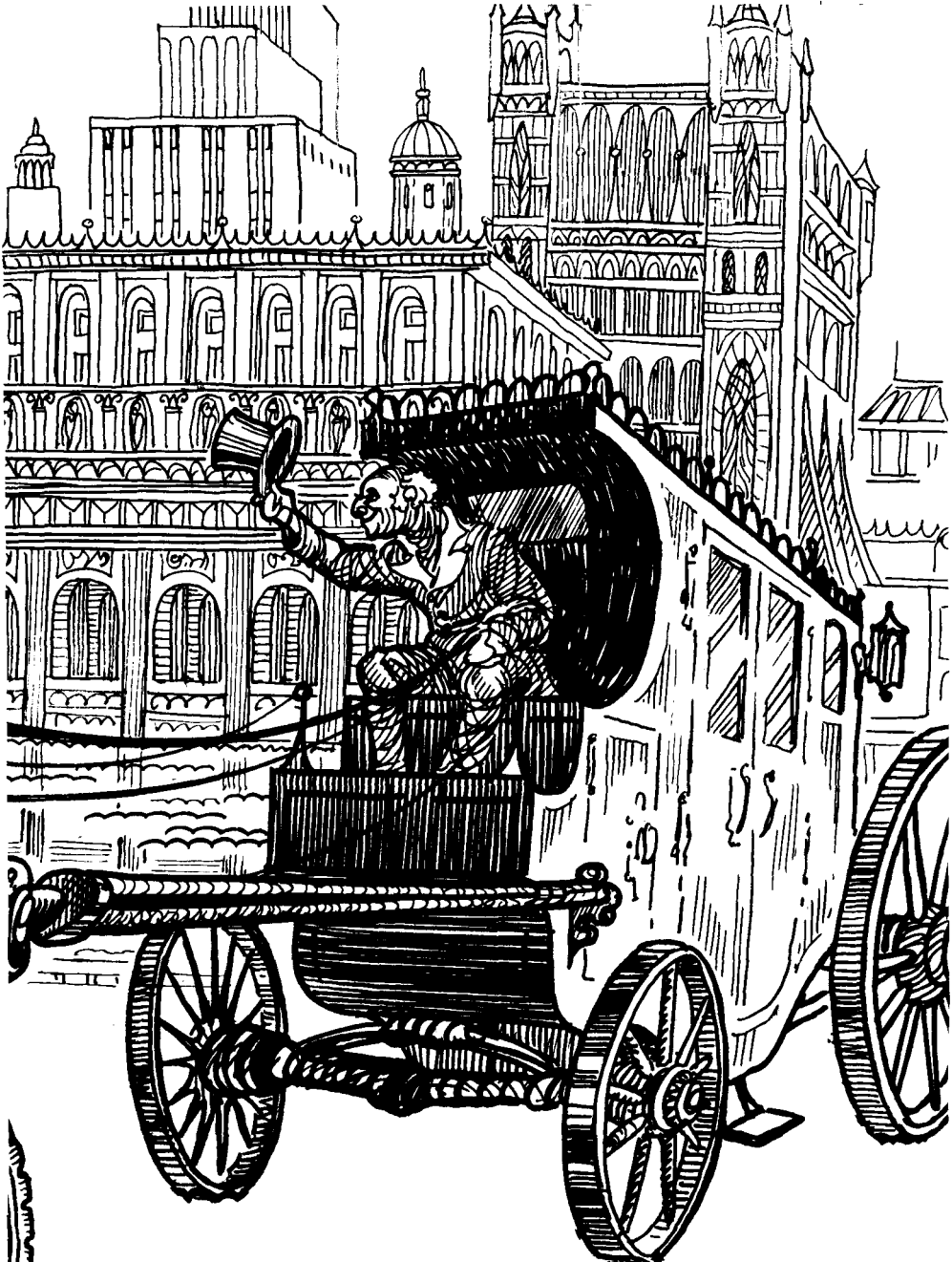

a transatlantic tunnel, hurrah!

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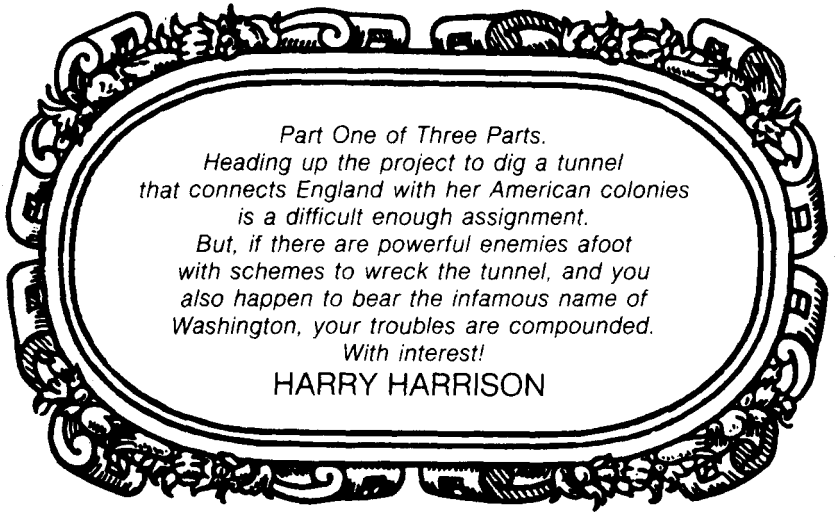

Part One of Three Parts.
Heading up the project to dig a tunnel
that connects England with her American colonies
is a difficult enough assignment.
But, if there are powerful enemies afoot
with schemes to wreck the tunnel, and you
also happen to bear the infamous name of
Washington, your troubles are compounded.
With interest!

HARRY HARRISON

I.

Leaving Paddington Station the *Flying Cornishman* seemed little different from any other train. Admittedly the appointments were cleaner and newer and there was a certain opulence to the gold tassels that fringed the seat cushions in the first-class carriage, but these were just a matter of superficial decoration. The differences that made this train unique in England, which was the same as saying unique in the entire world, were not yet apparent as the great golden engine nosed its way over the maze of tracks and switches of the station yards, then out through the tunnels and cuttings. Here the roadbad was ordinary and used by all trains alike.

Only when the hulking locomotive and its trailing cylinder of closely joined coaches had dived deep under the Thames and emerged in Surrey did the real difference show. For now even the roadbed became unusual, a single track of continuously welded rails on specially cushioned sleepers that was straighter and smoother than any track had ever been before, sparkling in deep cuttings that slashed a direct channel through the chalk of the downs, shooting arrow-straight across the streams on stumpy iron bridges, a no-nonsense rail line that changed direction only in the longest and shallowest of curves. The reason for this became quickly apparent as the acceleration of the train steadily increased until the nearby fields and trees flashed by, visible as just the most instantaneous of green blurs; only in the distance could details be

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picked out, but they, too, slipped backwards and vanished almost as soon as they had appeared.

Albert Drigg had the entire compartment to himself and he was very glad of that. Although he knew that this train had made the return trip from Penzance every day for almost a year now and had suffered no mishap, he was aware of this only in theory, so that now experiencing it in practice was a totally different matter. From London to Penzance was a total of two hundred eighty-two miles and that entire incredible distance would be covered in exactly two hours and five minutes—an average speed including stops of well in excess of one hundred fifty miles per hour. Was man meant to go that fast?

Albert Drigg had a strong visceral sensation that he was not. Not even in this year of Our Lord 1973, modern and up to date though the Empire was. Sitting so bolt upright in his black suit and black waistcoat that they showed no wrinkles, his stiff white collar shining, his gleaming leather portfolio on his knees, he generated no sign of his internal emotions. On the rack above, his tightly rolled umbrella and black bowler indicated he was a City man and men of the City of London are just not given to expressing their innermost feelings in public. Nevertheless he could not suppress a slight start when the compartment door whisked open on silent runners and a cheerful cockney voice addressed him.

"Tea, sir, tea?"

One hundred and fifty miles an hour—or more!—and the cup remained in place on the ledge beneath the window while the tea poured into it in a steady stream.

"That will be thrupence, sir."

Drigg took a sixpence from his pocket and passed it over to murmured thanks, then instantly regretted his largesse as the door closed again. He must be unnerved if he tipped in so magnanimous a manner, but he was solaced by the fact that he could put it on the expense account since he was traveling on company business. And the tea was good, freshly brewed and hot, and did very much to soothe his nerves. A whiskey would do a lot more he realized and he almost touched the electric button for the waiter when

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he remembered the Saloon Car, often seen in the pages of *The Tatler* and *Pall Mall Gazette*, but visited only by the very few. He finished the tea and rose, tucking the extra length of chain back into his sleeve. It bothered him that the portfolio was irremovably shackled to the cuff about his wrist and indicated that he was something less than a complete gentleman, but by careful maneuvering he could keep the chain from the public view. The Saloon Car, that was the very thing!

The carpeting in the corridor was a deep gold in color making a subtle contrast with the ruddy oiled gloss of the mahogany paneling. Drigg had to pass through another coach to reach the Saloon Car, but there was no need to struggle with recalcitrant doors as on an ordinary train for as he approached some concealed device detected his proximity and the doors opened swiftly before him to the accompaniment of the hum of hidden electric motors. Naturally he did not look through the compartment windows he passed, but out of the corners of his eyes he had quick glimpses of finely dressed men and elegantly attired women, some children sitting sedately, reading—then a sudden loud barking that inadvertently drew his eye. Two country gentlemen sat with their feet up, emptying a bottle of port between them while a half dozen hounds of various breeds and sizes milled about and sought after their attention. And then Drigg was at the Saloon Car.

No automatic devices here but the best of personal services. A grand carved door with massive brass handles and a pillbox capped boy, his double row of uniform buttons glinting and catching the eye, who saluted and tugged at the handles.

"Welcome, sir," he piped, "to the Grand Saloon Car of the London and Land's End Railway."

Now that he saw it in its full splendor Drigg realized that the newspaper photographs did not do the establishment justice. There was no feeling at all of being in a railway carriage, for the atmosphere was rather that of an exceedingly exclusive club. One side contained immense crystal windows, from floor to ceiling, framed by ruddy velvet curtains, while arrayed before them were the tables where the clientele could sit at their leisure and watch the rural countryside speeding by. The long bar was opposite, massed with ranked bottles that reflected in the fine cut glass mirror behind it.

There were windows to right and left of the bar, delicately constructed stained glass windows through which the sun poured to throw shifting colored patterns upon the carpet. No saints here, unless they be the saints of railroading like Stephenson or Brunel, sturdy far-seeing men with compasses and charts in hand. They were flanked by the engines of history with Captain Dick's Puffer and the tiny Rocket on the left, then

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progressing through history and time to the far right where the mighty atomic powered Dreadnought appeared, the juggernaut of the rails that pulled this very train.

Drigg sat by the window, his portfolio concealed beneath the table and ordered his whiskey, sipping at it slowly while he enjoyed the gay music-hall tune that a smiling musician was playing on the organ at the far end of the car.

This was indeed luxury and he relished every moment of it, already seeing the dropping jaws and mute stares of respect when he told the lads about it back at the King's Head in Hampstead. Before he had as much as finished his first drink the train was easing to a stop in Salisbury, where he looked on approvingly as a policeman appeared to chase from the platform a goggling lot of boys in school jackets who stood peering into the car. His duty done the officer raised his hand in salute to the occupants then rolled majestically and flatfootedly on about his official affairs.

Once more *The Flying Cornishman* hurled itself down the track and with his second whiskey Drigg ordered a plate of sandwiches, still eating them at the only other stop, in Exeter, while they were scarcely done before the train slowed for Penzance and he had to hurry back for his hat and umbrella.

The guards were lined up beside the locomotive when he passed, burly, no-nonsense looking soldiers of the Argyll and Sutherland Highlanders, elegant in their dark kilts and white gaiters, impressive in the steadiness of their Lee-Enfield rifles with fixed bayonets. Behind them was the massive golden bulk of the Dreadnought, the most singular and by far the most powerful engine in the world. Despite the urgency of his mission Drigg slowed, as did all the other passengers, unable calmly to pass the gleaming length of her.

Black driving wheels as tall as his head, drive rods thicker than his legs that emerged from swollen cylinders leaking white plumes of steam from their exhausts. She was a little travel-stained about her lower works but all her outer skin shone with the seamless, imprisoned-sunlight glow of gold, fourteen-karat gold plating, a king's ransom on a machine this size.

But it wasn't the gold the soldiers were here to guard, though that was almost reason enough, but the propulsive mechanism hidden within that smooth, unbroken, smokestackless shell. An atomic reactor, the government said, and little else, and kept its counsel. And guarded its engine. Any of the states of Germany would give a year's income for this secret while spies had already been captured who, it was rumored, were in the employ of the King of France. The soldiers sternly eyed the passersby and Drigg hurried on.

The works offices were upstairs in the station building and a lift carried him swiftly to the fourth floor. He

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was reaching for the door to the executive suite when it opened and a man emerged, a navvy from the look of him, for who else but a railway navvy would wear such knee-high hobnailed boots along with green corduroy trousers? His shirt was heavy canvas and over it he wore a grim but still rainbow waistcoat, while around his pillar-like neck was wrapped an even gaudier handkerchief. He held the door but barred Drigg's way, looking at him closely with his pale blue eyes which were startlingly clear in the tanned nut-brown of his face.

"You're Mr. Drigg, aren't you, sir?" he asked before the other could protest. "I saw you here when they cut t'tape and at other official functions of t'line."

"If you please."

The thick-thewed arm still prevented his entrance and there seemed little he could do to move it.

"You wouldn't know me, but I'm Fighting Jack, Captain Washington's head ganger, and if it's the captain you want t'see he's not here."

"I do want to see him and it is a matter of some urgency."

"That'll be tonight then, after shift. Captain's up t'the face. No visitors. If you've messages in that bag, I'll bring 'em up for you."

"Impossible, I must deliver this in person." Drigg took a key from his waistcoat pocket and turned it in the lock of the portfolio then reached inside. There was a single linen envelope there and he withdrew it just enough for the other to see the golden crest on the flap. Fighting Jack dropped his arm.

"The marquis?"

"None other." Drigg could not keep a certain smug satisfaction from his voice.

"Well, come along then. You'll have to wear overalls, it's mucky up t'face."

"The message must be delivered."

There was a work train waiting for the head ganger, a stubby electric engine drawing a single open car with boxes of supplies. It pulled out as soon as they were aboard and they rode the footplate behind the engineer. The track passed the town, cut through the fields, then dived into a black tunnel where the only light was a weak glow from the illuminated dials so that Drigg had to clutch for support fearful that he would be tossed out into the jolting darkness. Then they were in the sunshine again and slowing down as they moved towards a second tunnel mouth. It was far grander than the other with a facing of hewn granite blocks and marble pillars that supported a great lintel that had been done in the Doric style. This was deeply carved with the words that still brought a certain catch to Drigg's throat, even after all his years with the company.

TRANSATLANTIC TUNNEL they read.

Transatlantic tunnel—what an ambition! Less emotional men than he

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had been caught by the magic of those words and, even though there was scarcely more than a mile of tunnel behind this imposing façade, the thrill was still there. Imagination led one on, plunging into the earth, diving beneath the sea, rushing under those deep oceans of dark water for thousands of miles to emerge into the sunlight again in the New World.

Lights moved by, slower and slower, until the work train stopped before a concrete wall that sealed the tunnel like an immense plug.

"Last stop, follow me," Fighting Jack called out and swung down to the floor in a movement remarkably easy for a man his size. "Have you ever been down t'tunnel before?"

"Never." Drigg was ready enough to admit ignorance of this alien environment. Men moved about and called to each other with strange instructions, fallen metal clanged and echoed from the arched tunnel above them where unshielded lights hung to illuminate a Dante-ish scene of strange machines, tracks and cars, nameless equipment. "Never!"

"Nothing to worry you, Mr. Drigg, safe as houses if you do the right things at the right time. I've been working on the railways and the tunnels all m'life and outside of a few split ribs, cracked skull, a broken leg and a scar or two I'm fit as a fiddle. Now follow me."

Supposedly reassured by these dubious references, Drigg followed the ganger through a steel door set into the concrete bulkhead that was instantly and noisily slammed shut behind them. They were in a small room with benches down the middle and lockers on one wall. There was a sudden hissing and the distant hammering of pumps and Drigg felt a strange pressure on his ears. His look of sudden dismay was noticed by Fighting Jack.

"Air, just compressed air, nothing more. And a miserable little twenty pounds it is too I can tell you, as one who has worked under sixty and more. You'll never notice it once you're inside. Here you go." He pulled a boiler suit from a locker and shook it out. "This is big enough to go over your clothes. I'll hold that wallet for you."

"It is not removable." Drigg shook out the length of chain for inspection.

"No key?"

"I do not possess it."

"Easily solved."

The ganger produced an immense clasp knife, with a swiftness and economy of motion that showed he had had sudden use for it before, and touched it so that a long gleaming blade shot out. He stepped forward and Drigg backed away.

"Now there, sir, did you think I was going to amputate? Just going to make a few sartorial alterations on this here garment."

A single slash opened the sleeve from wrist to armpit and another twitch of the blade vented the garment's side. Then the knife folded

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and vanished into its usual resting place while Drigg drew on the mutilated apparel, the portfolio easily passing through the rent cloth. When Drigg had it on Fighting Jack cut up another boiler suit—he had a cavalier regard for company property apparently—and bound it around the cut sleeve to hold it shut. By the time this operation was completed the pumps had stopped and another door at the far end of the air-lock room opened and the operator looked inside, touching his forehead when he saw Drigg's bowler.

A train of small hopper wagons was just emerging from a larger steel door in the bulkhead and Fighting Jack pursed his lips to emit an ear-hurting whistle. The driver of the squat electric locomotive turned at the sound and cut his power.

"That's One-eyed Conro," Fighting Jack confided to Drigg. "Terrible man in a dustup, thumbs ready all t'time. Trying to even the score you see for the one he had gouged out."

Conro glared out of his single reddened eye until they had climbed up beside him, then ground the train of wagons forward.

"And how's the face?" Fighting Jack asked.

"Sand." One-eyed Conro spat a globe of tobacco juice into the darkness. "Still sand, wet sand. Loose at the top so Mr. Washington has dropped the pressure so she won't blow, so now there's plenty of water at the bottom and all the pumps are working."

"'Tis the air pressure you see," Fighting Jack explained to Drigg as though the messenger were interested, which he was not. "We're out under t'ocean here with ten, twenty fathoms of water over our heads and that water trying to push down through the sand and get t'us all the time, you see. So we raise the air pressure to keep it out. But seeing as how this tunnel is thirty feet high there is a difference in the pressure from top to bottom and that's a problem. When we raise the pressure to keep things all nice at t'top, why then the water seeps in at t'bottom where the pressure is lower and we're like t'swim. But, mind you, if we was to raise the pressure so the water is kept out at t'bottom why then there is too much pressure at t'top and there is a possibility of blowing a hole right through to the ocean bottom and letting all the waters of the world down upon our heads. But don't you worry about it."

Drigg could do nothing else. He found, that for some inexplicable reason his hands were shaking so that he had to grip the chain about his wrist tightly so it did not rattle. All too soon the train began to slow and the end of the tunnel appeared clearly ahead. A hulking metal shield that sealed off the workers from the virgin earth outside and enabled them to attack it through door-like openings that pierced the steel. Drills were at work above, whining and grumbling, while mechanical

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shovels below dug at the displaced muck and loaded it into the waiting wagons. The scene appeared disorganized and frenzied, but even to Drigg's untutored eye it was quickly apparent that work was going forward in an orderly and efficient manner. Fighting Jack climbed down and Drigg followed him, over to the shield and up a flight of metal stairs to one of the openings.

"Stay here," the ganger ordered. "I'll bring him out."

Drigg had not the slightest desire to go a step farther and wondered at his loyalty to the company that had brought him this far. Close feet away from him was the bare face of the soil through which the tunnel was being driven.

Gray sand and hard clay. The shovels ripped into it and dropped it down to the waiting machines below. There was something sinister and frightening about the entire operation and Drigg tore his gaze away to follow Fighting Jack who was talking to a tall man in khaki wearing high-laced engineer's boots. Only when he turned and Drigg saw that classical nose in profile did he recognize Captain Augustine Washington. He had seen him before only in the offices and at Board meetings and had not associated that well-dressed gentleman with this burly engineer. But of course, no toppers here . . .

It was something between a shout and a scream and everyone looked in the same direction at the same instant. One of the navvies was pointing at the face of dark sand before him that was puckering *away* from the shield.

"Blowout!" someone shouted and Drigg had no idea what it meant except he knew something terrible was happening. The scene was rapid, confused, with men doing things and all the time the sand was moving away until suddenly a hole a good two feet wide appeared with a great sound like an immense whistle. A wind pulled at Drigg and his ears hurt and to his horror he felt himself being drawn towards that gaping mouth. He clung to the metal in petrified terror as he watched strong boards being lifted from the shield by that wind and being sucked forward, to splinter and break and vanish into oblivion.

A navvy stumbled forward, leaning back against the suction, holding a bale of straw up high in his strong arms. It was Fighting Jack, struggling against the thing that had suddenly appeared to destroy them all, and he raised the bale which was sucked from his grasp even as he lifted it. It hit the opening, was pressed flat, and hung there for an instant—then disappeared.

Fighting Jack was staggering, reaching for support to pull himself back to safety, his hand out to a steel bulkhead. His fingers were almost touching it, tantalizingly close, but he could not reach it. With a bellow, more of annoyance than fear, he rocked backwards, was lifted to his feet and dragged headfirst into the opening.

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For one, long, terrifying moment he stuck there, like a cork in a bottle, just his kicking legs projecting into the tunnel.

Then he was gone and the air whistled and howled freely again.

II.

All of the navvies, not to mention Albert Drigg, stood paralyzed by horror at the swiftness of the tragedy. Even these strong men, used as they were to a life of physical effort and hardship, accidents and sudden maiming, were appalled by the swiftness of the event. Only one man there had the presence of mind to move, to act, to break the spell that bound all of the others.

"To me," Captain Washington shouted, jumping to a bulwark of timbers that had been prepared for just this sort of emergency. Lengths of thick boards that were bolted to stout timbers to make a doorlike shield that stood as high as a man. It looked too heavy for one person to budge yet Washington seized the edge and with a concerted contraction of all his muscles dragged it forward a good two feet.

His action jolted the others into motion, rallying to him to seize the construction and lift it and push it forward. The pressure of the air tore it from their hands and slammed it against the face of the cutting, covering the blowout opening at last. There was still the strong hiss of air pushing through the cracks in the boards but the rushing torrent had now abated. Under Washington's instructions they hurried to contain and seal off the disaster. While above them, through the largest opening in the tunneling shield, a strange machine appeared, pushed forward by smoothly powerful hydraulic cylinders. It was not unlike a battleship gun turret, only in place of the cannon there were four long tubes that ended in cutting heads. These were placed against the sand above the blowout and instantly began revolving under the operator's control. Drilling swiftly they sank into the soft sand until the turret itself was flush against the face of the cutting. As soon as this was done the drilling stopped and valves were opened—and an instant frosting of ice appeared upon the turret.

While this was happening a brawny navvy with an ax had chopped a hole in the center of the wooden shield just over the opening of the blowout. The pressure was so strong that, when he holed through, the ax was torn from his hands and vanished. He stumbled back, laughing at the incident and holding up his hands so his buddies could see the raw stripes on his palms where the handle of the ax had been drawn from his tight grip. No sooner had he stepped aside than the mouth of a thick hose was placed over this new opening and a pump started to throb.

Within seconds the high-pitched whistle of the escaping air began to

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die away. Ice now coated the formerly wet sand through which the blowout had occurred and a chilling wave of cold air passed over them all. When the rushing wind had vanished completely, Washington ordered the pumping stopped and their ears sang in the sudden silence. The sound of a bell drew their attention as Captain Washington spun the handle on the field telephone.

"Put me through on the radio link to the boat at once."

They all listened with a fierce intentness as contact was established and Washington snapped the single word, "Report." He listened and nodded then called out to his intent audience.

"He is safe. Alive and well."

They cheered and threw their caps into the air and only desisted when he raised his hands for silence.

"They saw the blowout on the surface, blowing muck and spray forty feet into the air when it first holed through. They went as close as they dared to the rising bubbles then and were right on the spot when Fighting Jack came by. Rose right up into the air, they said, and they had him almost as soon as he fell back. Unconscious and undamaged and when he came to he was cursing even before he opened his eyes. Now back to the job, men, we have twelve feet more to go today."

As soon as the rhythm of the work had resumed, Captain Washington turned to Drigg and put out his hand in a firm and muscular handshake.

"It is Mr. Drigg, isn't it? The marquis's private secretary?"

"Yes, sir, and Secretary of the Board as well."

"You have caught us at a busy moment, Mr. Drigg, and I hope you were not alarmed. There are certain inherent difficulties in tunneling but, as you have seen, they are not insurmountable if the correct precautions are taken. There is a trough in the ocean bottom above us at this spot, I doubt if more than five feet of sand separate us from the water. A blowout is always a possibility. But prompt plugging and the use of the Gowan stabilizer quickly sealed the opening."

"I'm afraid it is all beyond me," said Drigg.

"Not at all. Simple mechanics." There was a glint of true enthusiasm in Captain Washington's eye as he explained. "Since the sand is water-soaked above us the compressed air we use to hold back the weight of the water blew an opening right through to the sea bottom. The wooden barricade sealed the opening temporarily while the Gowan stabilizer could be brought up. Those drills are hollow and as soon as they were driven home liquid nitrogen was pumped through them. This fluid has a temperature of 345.5 degrees below zero and it instantly freezes everything around it. The pipe you see there pumped in a slurry of mud and water which froze solid and plugged the opening. We shall keep it frozen

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while we tunnel past this dangerous area and seal it off with the castiron sections of tunnel wall. All's well that ends well—and so it has."

"It has indeed, and for your head ganger as well. How fortunate the boat was nearby."

Washington looked at the other keenly before answering. "Not chance at all as I am sure you know. I do believe the last letter from the directors drawing my attention to the wasteful expense of maintaining the boat at this station was over your signature?"

"It was, sir, but it appeared there only as the drafter of the letter. I have no responsibility in these matters being just the vehicle of the directors' wishes. But with your permission I shall give a complete report of what I have seen today and will stress how a man's life was saved because of your foresight."

"Just good engineering, Mr. Drigg."

"Foresight, sir, I insist. Where you put a man's life ahead of money. I shall say just that and the matter will be laid to rest once and for all."

Washington seemed slightly embarrassed at the warmth in Drigg's voice and he quickly sought to change the subject.

"I have kept you waiting too long. It must have been a matter of some importance that has brought you personally all this distance."

"A communication, if you please."

Drigg unlocked the portfolio and took out the single envelope it contained. Washington raised his eyebrows slightly at the sight of the golden crest, then swiftly broke the seal and read the letter.

"Are you aware of the contents of this letter?" asked Washington, drawing the folded sheet of paper back and forth between his fingers.

"Only that the marquis wrote it himself and instructed me to facilitate in every way your return to London on a matter of some importance. We will be leaving at once."

"Must we? The first through connection on an up train is at nine and it won't arrive until the small hours."

"On the contrary," Drigg said, smiling. "A special run of *The Flying Cornishman* has been arranged for your convenience and should be now waiting."

"It is that urgent then?"

"The utmost, his lordship impressed that upon me most strongly."

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"All right then, I will have to change . . ."

"Permit me to interrupt. I believe instructions were also sent to the head porter of your hotel and a packed bag will be awaiting aboard the train."

Washington nodded acceptance; the decision had been made. He turned about and raised his voice over the growing din. "Bullhead. You will be head ganger here until Fighting Jack returns. Keep the work moving."

There was no more to be done. Washington led the way back through the shield to the electric locomotive which he commandeered for the return trip. They took it as far as the bulkhead and arrived just in time to meet Fighting Jack emerging from the air-lock door.

"Damn me if I want to do that again," he bellowed, his clothes still dripping wet, bruises on his head

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and shoulders where he had been dragged through the ocean bottom. "Like a cork in a bung I was, stuck and thought it me last moments. Then up like a shot and everything getting black and the next I know I'm looking up t'sky and at the faces of some ugly sinners and wondering if I were t'heaven or the other place."

"You were born to be hanged," said Washington calmly. "Back to the face now and see they work the shift out without slackening."

"I'll do that and feed any man who shirks into a blowout and up the way I went."

He turned and stamped off while they entered the air lock and found seats.

"Should he be working . . .?" Drigg ventured after long minutes of silence.

"He shouldn't—but I cannot stop him. These navvies have a way of life different from ours and we must respect it. If he's hurt, or has the bends, he would never admit it and the only way to get him to a hospital would be to bash him over the head and he would never forgive me. I have seen these men, on a dare, jump over the open mouth of a ventilation tunnel ten feet wide and a hundred feet deep. I have seen three men in a row fail and fall to their deaths and the fourth man, laughing, succeed. Then he and all the others there go out and drink beer until they can no longer walk in memory of their dead buddies. And no one regretting or worrying about a thing. A hard and brutal life you might say, but, by God, it makes men."

As though ashamed of this emotional outburst, Washington kept his counsel for the rest of the trip out of the tunnel, until they reached the platform in Penzance. It was dark now with the last bars of red fading from the clouds in the west. Lights were winking on all over the expanse of tracks as the yardboys went about refilling the switch beacons with paraffin and lighting their wicks. The crowds were gone, the station silent, while the solitary form of the Dreadnought bulked even larger than life with its newly polished golden cladding catching and holding the red and green of the switch lights. There were only two carriages attached, the Saloon Car and Monarch of the Glens, the private coach used only by the marquis or other members of the board of directors. The porter for this car, an elderly white-haired man named Walker, formerly the butler of one of the Board members, now retired to this sinecure in his advancing years, was waiting at the steps to the car.

"Your bath is drawn, sir, and your clothing laid out."

"Capital—but I must have a drink first. Join me if you will, Mr. Drigg, it has been a long and hot day with more than enough excitement for a month."

"A pleasure."

The gaudily uniformed boy was

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on the door to the Saloon Car, smiling as he drew it open for him. Washington stopped short when he saw him. "Should not this infant be in bed? Goodness knows we can open the door ourselves on this special trip."

The child's face fell and his lower lip showed a tendency to wobble before Drigg spoke. "They are volunteers all, Captain Washington, Billy here along with the rest. They want to go, you must understand that."

"Then go we shall," Washington laughed and entered the car. "Send a lemonade out to Billy and we will all have that drink."

The organist looked over his shoulder, smiling out a fine display of gold teeth, and enthusiastically played "Pack Up Your Troubles" as soon as they entered. Washington sent him over a pint of beer then raised his own and drained it in almost a single swallow. The train slipped forward so smoothly that they were scarcely aware that they were underway.

What with a few drinks and bathing and dressing the trip was over almost before Washington knew it. The platform at Paddington Station was empty except for the shining eighteen foot long, six-doored, black form of a Rolls-Royce waiting for them. The footman held the door, and as soon as they were inside and he had joined the chauffeur they were in motion again. Around Hyde Park and up Constitution Hill by Buckingham Palace—windows all aglitter with a ball or some important function—and within short minutes they were pulling up in front of Transatlantic House, the company offices in Pall Mall. The front doors were held open and not a word was spoken as Drigg led the way to the lift and up to the library. They stood there in the silence of morocco and dark wood until the porter had closed the outer door, and only then did Drigg touch a hidden catch on one of the shelves of books. An entire section of shelving opened like a door and he pointed through it.

"His Lordship is waiting in his private office. He thought to have a word with you alone before you go in to the Board. If you will." Washington stepped forward while the secret doorway closed behind him and another door opened before.

The marquis was writing at his desk and did not at first look up. This was an elegant room, rich with silver and brass and heavy with ancestral portraits. Behind the marquis the curtains were open so the large bay window framed the view across St. James's Park with the tower of Big Ben visible beyond. As it solemnly struck the hour the marquis laid down his pen and waved Washington to the nearby chair.

"It is a matter of some urgency," said he, "or I would not have rushed you away from your work in this cavalier manner."

"I realized that from the tone of

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your note. But you did not say what the matter was."

"We'll come to that in a moment. But I have asked you here, to see me alone, on what, for lack of a better term, might be called a personal matter."

His lordship seemed ill at ease. He tented his fingers together before him, then dropped them flat, rubbed at the wide jaw so typical of his line, then turned about to look out the window, then swung about again.

"This is difficult to say, Captain Washington, and has to do with our respective families. We have ancestors, there might be ill will, don't mean to infer, but you understand."

Washington did understand and felt some of the same embarrassment as the marquis. He had lived with this burden all his life so was better able to face it. Perhaps it would be best to have it out in the open than kept as a guilty secret.

"What is past is past," said he. "It is a matter of history and common knowledge that the first Marquis Cornwallis executed my ancestor George Washington as a traitor. I feel no shame at the fact, nor any personal animosity towards you or your family, you may take my word on that. The Battle of Lexington was fairly fought and fairly won and the Continental Army defeated. The first marquis was a soldier and could do no more than obey his orders, no matter how distasteful he found them personally. As you know it was the king himself who ordered the execution. George Washington was a traitor—but only because he lost. If he had won, he would have been a patriot and he deserved to win because his cause was a just one."

"I'm afraid I'm not so well read up on that period of history," Cornwallis said, looking down at his desk.

"You will excuse my outspokenness, your lordship, but this is something very close to me. Because of the revolt and the ill feelings that followed after it in the American colonies we remain a colony to this day. While others, Canada and Australia for example, have attained to full independent dominion status within the Empire. You had better know that I am active in the Independence movement and will do everything I can to hurry the day when Her Majesty will approve that status."

"I could not agree more warmly, sir! As you undoubtedly know I am a man of firm Tory persuasion and strongly back my party's position that dominion status be granted in the manner you say."

He rose and pounded the desk soundly as he said this, then extended his hand to the other, a social grace he had chosen to ignore when Washington had entered, undoubtedly because of the delicate nature of their familial relationship. Washington could do no less so stood and shook the hand firmly. They stood that way for a long moment then the marquis dropped his eyes and released Washington's hand, coughing

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into his fist to cover his embarrassment at this unexpected display of emotion. But it had cleared the air for what was to come.

"We are upon difficult times with the tunnel, Washington, difficult times," said Cornwallis and his expression became as difficult as the times he alluded to with his forehead furrowed as a plowed field, the corners of his mouth drooping so far that his ample jowls fell an inch. "This immense project has worn two faces since the very beginning and the private face is the one I allude to now. I am sure that you have some idea of the intricate financing of an enterprise this size but I do not think you are aware of how political in nature the major considerations are. In simple—this is a government project, a sort of immense works program. You are shocked to hear this?"

"I must admit, sir, that I am, at the minimum, surprised."

"As well you might be. This country and its mighty Empire are built upon the sound notion that strong men lead while others follow, weak men and inept corporations go to the wall, while the government and the crown keeps its nose out of private affairs. Which is all well and good when the economic weather is fair and the sun of the healthy pound beams down upon us all. But there are clouds across the face of that sun now as I am sure you are well aware.

While the frontiers were expanding England grew fat with the wealth of the East India Company, the Hudson's Bay Company, the Inca-Andean Company and all the others flowing our way. But I am afraid the last frontier has been pushed back to the final ocean and a certain placidity has settled upon the world and its economy. When businesses can no longer expand they tend to contract and this industrial contractionism is rather self-perpetuating. Something had to be done to stop it. More men on the dole every day, workhouses full, charities stretched to the limit. Something, I say, had to be done. Something was done.

"Certain private businessmen, certain great corporations, met *in camera* and—with considerable reluctance I can assure you—decided that the overall solution of the problem was beyond them. Learned specialists in the field of economics were drawn into the discussions and at their insistence the still highly secret meetings were enlarged to include a committee from the Parliament. It was then that the tunnel project was first voiced, a project large enough to affect and stimulate the entire economy of both Britain and the American colonies. Yet its very size was its only drawback; not enough private capital could be raised to finance it. It was then that the final, incredible step was taken. Crown financing would be needed." He lowered his voice unconsciously. "The Queen was consulted."

This was a revelation of a stagger-

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ing nature, a secret of state so well kept that Washington, privy as he was to the innermost operations of The Transatlantic Tunnel Company, had not the slightest intimation of the truth until this moment. He was stunned at first, then narrowed his eyes in thought as he considered the ramifications. He was scarcely aware that the marquis rose and poured them each a sherry from the cut crystal decanter on the sideboard, though his fingers took it automatically and raised it to his lips.

He finally spoke. "Can you tell me what is the degree of involvement of the government?"

"In for a penny, in for a pound. Private investors have so far subscribed about twelve percent of the needed sum. Her Majesty's Government has agreed to take eighty percent—but no more."

"Then we are eight percent short of our goal?"

"Precisely." The marquis paced the length of the room and back, his hands clasped behind him and kneading one another. "I've had my doubts from the beginning, God knows we have all had our doubts. But it was Lord Keynes who had his way, Queen's adviser, author of I don't know how many books on economics, ninety years if he is a day and still spry enough to take on all comers. He had us all convinced, it sounded so good when he told us how well it would work. Money in circulation, capital on the move, healthy profits for investors, businesses expanding to meet the needs for building the tunnel, employment all around, pay packets going out to the small merchants, a healthy economy."

"All of those things could be true."

"Damme, all those things *will* be true—if the whole thing doesn't go bust first. And it will go bust and things will be back to where they were, if not worse, unless we can come up with the missing eight percent. And, you will pardon my frankness, my boy, but it is your bloody fellow colonials who are tugging back on the reins. You can help us there, possibly only you can help us there. Without overexaggerating I can say the fate of the tunnel depends upon you."

"I will do whatever is needed, sir," Washington said quietly and simply. "You may count upon me."

"I knew I could, or I would not have had you here. Forgive my bad manners, it's been a deucedly long day and more to come. We have an agreement with your Colonial Congress and the Governor General—yes they were consulted, too; your economy shares the same debilitations as ours—to match equally all monies raised by private investors in the Americas. There has been but a trickle where we needed a flood. Radical changes are needed. You, of course, know Rockefeller, chairman of the American Board, and Macintosh, Brassey-Brunel's agent in

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charge of the construction at the American end. Both have agreed, in the course of the greater good, that they will step down. The two positions will be combined into one and you will be nominated tonight to fill it."

"Good God!" Washington gasped.

"May He approve and be on our side. Our first consideration was that the candidate be a good engineer, and you are that. We know you will do the work. The second is that you are a Colonial, one of their own people, so the operation has a definite American ring to it. I realize that there are some among the Tories who hold your family name anathema, we must be frank, but I feel they are in a minority. Our hope is that this appointment and your efforts will spur the lagging sales of bonds that will permit the operation to continue. Will you do it?"

"I gave my word, I will not withdraw it now. But there will be difficulties . . ."

"A single difficulty, and you can put the name to it."

"Sir Isambard. The design of the tunnel is all his, the very conception indeed. I am just an employee carrying out his orders as is his agent Macintosh, who is not even an engineer. If I am to assume this greater responsibility, I will be something close to his equal in all matters. He is not going to like it."

"The understatement of the century, my boy. He has been sounded out cautiously already with the predictable results." A light flashed on the desk and was accompanied by a soft beeping sound. "The Board has returned after their dinners and I must join them since no one is to know I have seen you. If you will be so kind as to wait in the library, you will be sent for. If matters go as we have planned, and they will since we have the votes, you will be sent a note outlining these proposals and then called before the Board. There is no other way."

The door opened at a touch of a button on the desk and Washington found himself back in the library.

There was a soft leather armchair there that he sank into gratefully and when, a few minutes later, Drigg came to inquire if he needed anything he was deep in thought and roused up only long enough to shake his head in the negative. For this was without a doubt the pinnacle of his career—if only he could scale it. Yes, he could, he had no doubts about that, had been without doubts since he had left Mount Vernon for the last time, waving good-bye to his mother and sister at the gate of the simple cottage that was their ancestral home. A cottage that had been built in the shadow of the ivy-grown ruins of that greater house burnt by the Tory mobs.

He was already an engineer then, graduated first in his class from M.I.T. despite the dishonor attached to his name—or perhaps because of it. Just as he had fought many a dark

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and silent battle with his fists behind the dorms so had he fought that much harder contest in school to stay ahead, to be better, fighting with both his fists and his mind to restore honor to his family name. After graduation he had served his brief stint in the Territorial Engineers—without the R.O.T.C. grant he would never have finished college—and in doing so had enjoyed to its utmost his first taste of working in the field.

There had been the usual troubles at the western frontier with the Spanish colonies so that the Colonial authorities in New York had decided that a military railroad was needed there. For one glorious year he had surveyed rights of way through the impassable Rocky Mountains and labored in the tunnels that were being driven through the intractable rock. The experience had changed his life and he had known just what he wanted from that time on. Along with the best minds from all the far-flung schools of the Empire he had sat for the prestigious George Stephenson scholarship at Edinburgh University and had triumphed. Acceptance had meant automatic entrance into the higher echelons of the great engineering firm of Brassey-Brunel and this, too, had come to pass.

Edinburgh had been wonderful, despite the slightly curled lips of his English classmates towards his colonial background, or perhaps because of this. For the first time in his life he was among people who attached no onus to his name; they could not be expected to remember the details of every petty battle fought at the fringes of their Empire for the past four hundred years. Washington was just another colonial to be classified with Hindoos, Mohawks, Burmese, Aztecs and others and he reveled in this group anonymity.

His rise had been brief and quick and now he was reaching the summit. Beware lest he fall when his reach exceeded his grasp. No! He knew that he could handle the engineering, drive the American end of the tunnel just as he was driving the British one. And though he was aware that he was no financier he also knew how to talk to the men with the money, to explain just what would be done with their funds and how well invested they would be. It would be Whig money he was after—though perhaps the Tories would permit greed to rise above intolerance and would climb on the bandwagon when they saw the others riding merrily away towards financial success.

Most important of all was the bearing this had upon a more important factor. Deep down he nursed the unspoken ambition to clear his family name. Unspoken since that day when he had blurted it out to his sister Martha and she had understood, when they had been no more than children. Everything he accomplished, in some manner, reflected on that ambition, for what he accomplished in his own name was also

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done in the name of that noble man who had labored so hard for his country, who in return for his efforts was felled by a volley of English bullets.

"Captain Washington, Captain Washington, sir."

The voice penetrated the darkness of his thoughts and as it did he realized he had been hearing it for some time and not heeding. He started and took the envelope that Drigg held out to him, opened it and read it, then read it a second time more slowly. It was as Lord Cornwallis had said, the motion had been passed, he was being offered the post.

"If you will come with me, sir."

He rose and brushed the wrinkles from his waistcoat and buttoned his jacket. With the note still in his hand he followed the secretary to the boardroom to stand at the foot of the long dark table. The room was silent, all eyes upon him, as Cornwallis spoke from his place at the head of the table.

"You have read and understood our communication, Captain Washington?"

"I have, sir. It appears to be a request to fill, in a single capacity, the dual positions now occupied by Sir Winthrop and Mr. Macintosh. You indicate that these gentlemen approve of the change?"

"They do."

"Then I am most pleased to accept—with but one reservation before I do. I would like to know Sir Isambard's feelings on the change."

It was the waving of a red flag to a bull, the insulting of the Queen to a loyal Englishman, the use of the word frog to a Frenchman. Sir Isambard Brassey-Brunel was on his feet in the instant, leaning both fists hard on the polished rosewood of the table, fire in his eye and white anger in the flare of his nostril. A small man before whom, in his anger, large men trembled, yet Washington was not trembling because perhaps he was not the trembling type.

A study in opposites they were, one tall, one slight, one middle-aged and smooth of skin whose great breadth of forehead grew greater with the passing days, the other with a forehead of equal magnitude but with a face browned and lined by sun and wind. A neatly turned out English gentleman from the tips of his polished, handcrafted boots to the top of his tonsured head—with a hundred guineas of impeccable Savile Row tailoring in between. A well-dressed Colonial whose clothes were first class yet definitely provincial, like the serviceable and rugged boots intended more for wear than show.

"You wish to know my feelings," Sir Isambard said, "you wish to know my feelings." The words were spoken softly yet could be heard throughout all of that great room and perhaps because of this gentleness of tone were all the more ominous. "I will tell you my feelings, sir, strong feelings that they are, sir. I

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am against this appointment, completely against it and oppose it and that is the whole of it."

"Well then," Washington said, seating himself in the chair placed there for his convenience, "that is all there is to it. I cannot accept the appointment."

Now the silence was absolute and if a silence could be said to be stunned this one certainly was. Sir Isambard was deflated by the answer, his anger stripped from him, and as anger, like air from a balloon, leaked from him he also sank slowly back into his seat.

"But you have accepted," Cornwallis said, baffled, speaking for all of them.

"I accepted because I assumed the Board was unanimous in its decision. What is proposed is a major change. I cannot consider it if the man by whom I am employed, the master architect of this construction, the leading engineer and contractor in the world, is against it. I cannot, in all truth, fly in the face of a decision like that."

All eyes were now upon Sir Isambard whose face was certainly a study worth recording in its rapid changes of expression that reflected the calculations of the mighty brain behind it. First anger, giving way to surprise, followed by the crinkling forehead of cogitation and then the blankness of conclusion ending with a ghose of a smile that came and went as swiftly as a passing shadow.

"Well said, young Washington; how does it go? You shall not speak ill of me, I am your friend, faithful and just upon you. I detect the quality of your classical education. The burden of decision now rests upon my shoulders alone and I shall not shirk it. I have the feeling that you know more of these matters than you intimate; you have been spoken to or you would not be so bold. But so be it. The tunnel must go through and to have a tunnel we apparently have to have you. I withdraw my objections. You are a good enough engineer I must admit and if you follow orders and build the tunnel to my design we will build well."

He reached out his small, strong hand to take up a glass of water, the strongest spirit he ever allowed himself, while something like a cheer echoed from all sides. The chairman's gavel banged through the uproar, the meeting was concluded, the decision made, the work would go on. Sir Isambard waited stolidly to one side while the members of the Board congratulated Washington and each other and only when the engineer was free did he step to his side.

"You will share a cab with me." It was something between a request and a command.

"My pleasure."

They went down in the lift together in silence and the porter opened the door for them and whistled for a cab. It was a hansom cab, two wheeled, high, black and sleek,

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the driver perched above with the reins through his fingers, these same reins leading down to one of the newfangled conversions that were slowly removing the presence of the horse from central London. Here there was no proud, high-stepping equine frame between the shafts, but instead a squat engine of some sort whose black metal, bricklike form rested upon three wheels. The single front wheel swiveled at a tug upon the reins bringing the hansom up smartly to the curb, while a tug on another rein stopped the power so it glided to a halt.

"An improvement," Sir Isambard said as they climbed in. "The horse has been the bane of this city, droppings, flies, disease, but no more. His replacement is quiet and smoothly electric powered with no noise or noxious exhaust like the first steam models, batteries in the boot—you will have noticed the wires on the shafts. Now close that trap because it is privacy not eavesdropping we want."

This last was addressed to the round and gloomy face of the cabby who peered down through the opening from above like a misplaced ruddy moon.

"Begging your pardon, your honor, but I've not heard the destination."

"One hundred and eight Maida Vale." The slam of the hatch added punctuation to his words and he turned to Washington. "If you had supposed you were returning with me to my home dispel yourself of the idea at once."

"I had thought . . ."

"You thought wrong. I wished only to talk with you in private. In any case Iris is at some sort of theological tomfoolery at Albert Hall this evening so we can be spared any scenes. She is my only daughter and she obeys me when she must, but she also shares my views of the world. When I explain to her that you have joined with my antagonists on the Board to deprive me of my full responsibilities, that you now may wish to obtain my position for yourself—"

"Sir!"

"Be quiet. This is a lecture, not a discussion. That you have taken the position occupied by one of my agents and have completely turned against me. When I tell her those things she will understand at once why I will bar my house from you in the future and she will return your ring to your club by messenger in the morning. We will continue our business relationship because there is no other way. But your engagement to my daughter is broken, you are no longer welcome in my home, and you will make no attempts, now or in the future, to contact Iris." He knocked loudly on the hatch with the head of his cane. "Stop the cab. Good-bye."

III.

A fine rain was falling, darkening even more the black pavement of

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Kensington Gore so that each yellow gaslight above had its mirror imaged fellow beaming back at it from the street below. The doors to the hall were closed, the street empty save for a single figure that appeared suddenly around the corner, a gentleman in a hurry and heedless of the inclemencies of the weather, his hat and clothes bedewed with raindrops. Taking the steps two at a time he threw open one of the outer doors of the hall and came face to face with the ample uniformed figure of the commissionaire who prevented any further forward motion by the sheer bulk of his presence.

"Performance begun, sir. Everyone seated."

"I wish to talk to someone in the audience," said Washington while at the same time forcing himself into some form of composure, realizing that his sudden appearance out of the night might be misinterpreted. "It is a matter of some urgency—I'll purchase a ticket if necessary."

"Dreadfully sorry, sir. Ticket window closed."

Washington already had his purse in his hand as these words were spoken which led naturally to a further and hopefully more successful attempt at entry. He slipped two half crowns into the man's hand.

"Are you sure there is no way? Perhaps I could just step inside and look around for my party?" There was a glint of silver that although instantly vanished still seemed to work a miraculous change on the doorkeeper's manner, for he stepped back and waved entrance with his hand.

"Perfectly understandable, sir. Walk this way."

The door closed silently behind his back and Washington looked around the partially filled hall. In the darkness he could make out only the fact that the audience seemed to be almost completely female and he wondered how he could possibly single out one singular and important female from all the others. They were listening in rapt silence to a small man with a gray beard and black skullcap who stood at the lectern on the platform. Behind him, incongruously enough, there was a red plush divan upon which lay a rather fat and ordinary looking woman who was either unconscious, or sleeping. The juxtaposition of this strangely matched pair was so arresting that, with no opportunity at the

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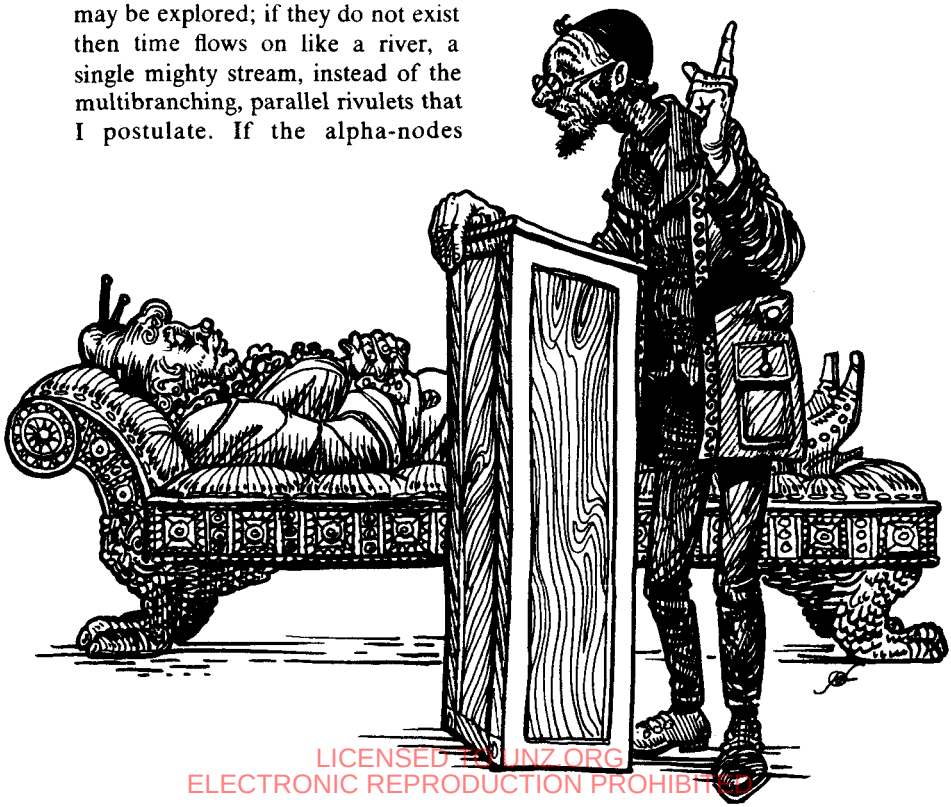
moment for seeking out Iris from the audience, despite himself, Washington found himself listening to the speaker.

". . . Have heard what Madame Clotilda has said, spoken the name Martin Alhaja Gontran, almost, in the understanding of her experience, shouted this name signifying the importance of said name. This relates to what I have spoken of earlier in the outlining of my theory of the multi-serial nature of time. There are these points in time which I have named alpha-nodes, and it is upon the existence of these alpha-nodes that my theory depends. If they exist, my theory has some validity and may be explored; if they do not exist then time flows on like a river, a single mighty stream, instead of the multibranching, parallel rivulets that I postulate. If the alpha-nodes are not there then I am wrong."

"Hear, hear," Washington said under his breath, searching for a singular dark and lovely head among all the rows of possibly dark and lovely heads before him.

"The search for a major alpha-node has taken years and Madame Clotilda is the first clairvoyant to have made contact, so difficult is the task. At first, with the greatest difficulty, she spoke the single word *Gontran* and I searched long and deep for the meaning. I thought I had found the correct reference and



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tonight before you it has been revealed that I was correct for when I said *Martin* she supplied the missing third part. Alhaja! The name, the all important complete name that pinpoints with exactitude our alpha-node. Martin Alhaja Gontran.

"Let me tell you who he was, this unimportant little man, this illiterate shepherd who held the creation of an entire world in the palm of his cracked and calloused hand. I ask you to consider the date the sixteenth of July in the year 1212. The scene is the Iberian peninsula and a mighty battle is in preparation between the Christian and the Moslim forces. They lie under arms in their separate camps, the watchfires burn low, they gather their strength for the battle of the morrow. But all are not asleep. This shepherd, this Martin Alhaja Gontran, has spoken to a friend about what he has planned to do and the friend has spoken to certain others and Gontran is apprehended by the Moors. These were uncivilized times and men did wreak pain and suffering upon their fellow men of a sort that I will not speak for the gentle ears of the members of the fairer inclination among my audience.

Suffice to say Gontran spoke before he died, and revealed the fact that he had planned to lead Christian troops that night by secret and unguarded paths that he knew of, being a shepherd, that would bring them behind the Muslim lines. He died and this was not done. Now I ask you to consider what *might* have happened if he had succeeded in his plan. It is very possible that the Christians instead of the Muslims might have won the battle of Navas de Tolosa the following day, possibly the most decisive battle of the period.

I ask you to speculate further. If they had won they might have gone on to further victories and the Iberian Peninsula might be another Christian country like France or Prussia, instead of being Muslim and part of the Greater Caliphate. Of what importance to us is this distant part of the continent you may ask, and I answer of the utmost because cause is linked inviably to event. Cause and event. With Christian rulers in Iberia . . ."

Behind him on the platform the sturdy form of Madame Clotilda began to stir and move while from her throat there came a sound somewhere between a sigh and a muffled gasp. The greater part of the audience gasped in echo and stirred as well so that Dr. Mendoza had to raise his hands for silence.

"It is fine, it is normal, do not disturb yourself I beg of you. See, the physician is here now, waiting ready in the wings in case of need. The strain upon the system is great for a clairvoyant and sometimes . . . haha, there is a little reaction which is quickly taken care of. See, the curtains close, the doctor is at her side,

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all will be well. I ask the houselights to be raised, I will return in a moment after a small intermission during which you will hear a recording of an Eskimo ritual chant I myself recorded in a winter camp of these hardy indigenees north of the Arctic Circle while determining the basic relationship of diurnal time to Circadian rhythms so important to the foundations of the alpha-node theory. I thank you."

With these words the lights came on and the little doctor, after a brief struggle to find the opening in the curtain, vanished from sight while their ears were assaulted by an inhuman and high-pitched wailing mixed with a dull thudding. Washington seized the unexpected opportunity and hurried down the aisle searching the audience for that certain face.

And there she was, in the second row, just in from the aisle, dark hair drawn back and held sweetly by a golden clasp, features perfect for she was indeed a startling beauty whom the newspaper photographers loved to find at balls. Her lips were as full and red without the touch of artifice as any other girl's after labor at the paintpot. As always he was without words when he first looked at her, filled with happiness to be in her presence. But she must have felt his eyes upon her for she glanced up and her startled expression broke into a smile of such warmth that, if possible, his powers of speech were removed even farther from accessibility.

"Why Gus, here! What a pleasant surprise." He smiled in response, capable of nothing more coherent. "Have you met Joyce Boardman? I don't think you have, she's just home from the far East. Joyce, my fiancé. Captain Augustine Washington."

He took the offered hand, bowing slightly, vaguely aware of an attractive female presence, nothing more. "A pleasure. Iris, I hate to break in like this but I've just come up from Cornwall and I'll be going back in the morning. Would it be possible to see you now, to talk to you?"

Other words were on her lips but she must have detected something unusual in his manner, or his voice, for she changed them before she spoke, and when she did so it was with a firm decisiveness unusual in a girl just past twenty.

"Of course. Madame Clotilda's fainting spell seems to have interrupted matters and if the doctor does speak again Joyce can tell me all about it tomorrow. That will be all right with you, won't it, Joyce dear?" Joyce dear had little chance to answer, or protest, because Iris went on in a rush of words perhaps to forestall any utterance of this type. "That's so kind of you. When the car comes tell them I've already gone home by cab."

Then she was on his arm and they were going up the aisle. While the commissionaire was calling a cab Washington realized that the issue had to be faced at once.

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"Before the cab comes I must tell you—your father and I have had a difference of opinion."

"The easiest thing in the world to do. I am at it all the time. Poor Daddy is certainly the firmest minded man in the world."

"I'm afraid this is more serious. He has forbidden me the house and, this is even harder to say, does not want us to see each other ever again."

She was silent in thought for a long moment and the happy smile slowly vanished from her face. But she held his arm no less tightly for which he loved her, if it were possible, ever much the more.

"Then we shall talk about it and you must tell me everything that has happened. We'll go—let me see—to the lounge in the Great Western Hotel at Paddington. It's on the way home and I remember you liked the tea and cakes there."

In the privacy of the cab, while they crossed the rain-filled darkness of Hyde Park, he told her what had happened. Told her everything except the irrelevant details of his confidential talk with Cornwallis, explained why the appointment was being made and how important it was both to the company and to him, then closed by repeating almost word for word the final and decisive conversation with her father. When he had finished they were already at the hotel and there was nothing more that could be said until they had climbed the grand staircase and been seated, ordered the tea and cakes, and it must be admitted a double brandy for him since he felt greatly in need of one, and the silence lasted until the tea had been poured.

"This is a terrible thing to have happen, Gus, a terrible thing."

"You don't think your father is right, do you?"

"I don't have to think whether he is right or not, I only have to remember that he is my father."

"Iris, darling, you can't mean that! You're a girl of the Twentieth Century, not a Victorian shadow of a woman. You have the vote now, or at least you will next year when you are of age, women have a freedom under Elizabeth they never knew before."

"We do, and I know it, and I do love you, dear Gus. But this cannot do away with my family ties. And you said it yourself, I have not attained my majority, nor will I for six months, and I still remain in my father's house."

"You can't mean—"

"But I do, and it hurts me to have to say it. Until you and Daddy resolve this terrible thing that has come between you I have only one thing I must do. Gus, darling Gus, I really have no choice."

There was a gasp and a welter of emotion in the last words she spoke, while a tear brimmed from the corner of each eye as she took the ring from the finger of her left hand and put it into his palm.

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IV.

What a glorious June day it was. Excitement filled the streets of Southampton and washed like breaking waves along her docks. The weather smiled as did the people, calling out to one another, drifting by twos and threes down towards the waterfront and the rapidly approaching hour of noon. Gay bunting and bright flags snapped in the offshore breeze while small boats scudded over the placid surface of the harbor like water bugs. A sudden sense of urgency came unto the strollers and they moved faster when a train's whistle sounded from the hills. The boat train from London; the passengers were here!

The echo of the whistle drew Gus Washington from the well of his work, away from the blueprints, charts, diagrams, figures, plans, devices, pounds, dollars and worries that snapped up at him out of the welter of papers he had spread about the train compartment. He pinched at the bridge of his nose where a persistent pain of fatigue nibbled him, then rubbed his sore eyes. He had been doing a good deal, some would say too much, but it was just a great amount of work that could not be avoided. Well enough for the moment. The tracks curved down towards the docks and he folded the scattered papers and documents and put them back into his bulging case, a sturdy, no-nonsense, heavy-strapped and brass-buckled case of horsehide, pinto pony hide to be exact with the gay white and brown pattern of the hair still there, a pony he had once ridden and ridden well to a good cause in the Far West, but that is another story altogether. Now as he filled the case and sealed it the train rattled across the points and out along the quay and he had his first sight of the *Queen Elizabeth* tied up at her berth ahead.

This was a sight for sore eyes that rendered them pain-free upon the instant. This was a marvel of engineering, of technical skill and daring the like of which the world had never seen before. So white she glistened in the sun, her bow pressed against the wharf and her distant stern far out in the stream. The gangplank reached up to the foredeck where a Union Jack flew proudly from a flagstaff. Out, far out, to both sides stretched the immense wings, white and wide, with the impressive bulk of the engines slung beneath them. Four to each side, eight in all, each with a four-bladed propeller, each blade of which was taller than a man. The *Queen Elizabeth,* pride of the Cunard Line, the grandest and most glorious flying ship in existence.

For six months she had been flying with her select crew, around the world, showing the flag in every ocean and on the shores of almost every land. If there had been any difficulties at all during this trial period the company had kept them a close secret. Now her extended proving flight was over and she would be-

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gin the run for which she had been designed, the prestigious North Atlantic route of the Queens, Southampton to New York nonstop, three thousand miles or more. Nor was it any accident that Gus Washington was on this flight, a simple engineer who ranked almost at the foot of the passenger list, overshadowed by the dukes and lords, the moguls of industry, the handful of European nobility and the great, titled actor. One hundred passengers only and at least ten or a hundred applicants for every berth.

There had been pressure in high places, quiet chats over port at certain clubs, discreet telephone calls. The affairs of the tunnel affected both high finance and the court and both were in agreement that everything must be done to encourage the American financial cooperation in the venture. Washington must go to the colonies, so let him go in the most fitting manner, a style that guaranteed the maximum publicity for the trip.

The maiden voyage of the flying ship was opportunity knocking. Opportunity that was admitted even before she rapped, although it meant that Gus had to pack a fortnight's work into five days. It was done, he was ready, the voyage was at hand. He sealed his case and opened the compartment door and joined the other passengers on the platform. There were not many and he held back so they could go ahead to the pop of flashbulbs and the click of the press cameras. Not all had come by train; the barrier that held back the swelling crowd was opened to admit two automobiles, high, black, ponderous Rolls-Royces. As it began to close behind them there was an imperious blast of a steam whistle from the street beyond and it hurriedly opened again to admit the extended form of a Skoda Steamer, a vehicle much favored by European royalty. It had six wheels, the rear driving pair almost twice the size of the two others, as well as a cabin to the rear that housed the engine and the stoker. It emitted a plume of steam again as its whistle sounded and it eased silently by trailing a faint cloud of smoke, the stately figures inside framed by the silver mounted window frames looking neither to right nor left. This was indeed a day to be remembered.

Further along the platform the station café was open, frequented apparently only by the press since the passengers appeared to be going directly aboard. Gus had a wonderfully cooling pint of bitter before he was recognized and collared by the gentlemen of the fourth estate. He talked with them easily and answered their questions about the tunnel frankly. Everything was fine, just fine, on schedule and forging ahead. The tunnel would be built, have no fear. They honored his request not to be photographed with the glass in his hand, since teetotal money was among the funds subscribed for the

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tunnel, and they accepted with thanks his offer of a round for all of them. The voyage was having an auspicious start.

When he emerged into the sunlight again the gangplank was clear and the passengers all boarded. Gus in turn climbed to the foredeck and accepted the salute of the ship's officer waiting there, a salute that hesitated and stopped halfway up from the sharply creased uniform leg to the shining billed cap and turned suddenly into an outstretched hand ready to clasp his.

"Hawkeye Washington—that is you!"

The clock of time rolled back in that instant and Gus was once more in digs at Edinburgh, in class, facing the driving rain while walking up Prince's Street. Hawkeye—legendary hero of a popular novel whose name was hung on most students from the American colonies. He smiled broadly and took the proffered hand and pressed it strongly.

"Alec, and that is you, isn't it, hiding behind all that R.A.F. moustache? Alec Durell."

"None other, Hawkeye, none other. And it was earned the hard way I must say," touching the great sweep of the thing with his knuckle as he spoke of it. "Donkey's years in the RAF, then Fleet Air Arm, finally to Cunard when they swept the services for our best flying people."

"Still shy I see?"

"As ever. Lovely to have you aboard. Look, come on to the bridge and meet the boys. I'm first engineer. They're a good lot. All ex-services, only place the company could find the fliers to handle an ark like this. Not a real company man in the pack if you don't count the purser and he isn't allowed on the bridge."

They went aft but bypassed the passenger entrance just below the high windows of the bridge and entered through a small doorway in the hull marked CREW ONLY. This led to an ample chamber, windowed to the sides and front and filled with instruments and controls. The helmsman was seated the farthest forward, with the captain and the first officer to his right and left. To the rear were the open doors of the small cubicles of the radio operator and the navigator. The walls were teak paneled, the fascia for the instruments of walnut and chrome, while the floor was covered wall to wall in a fine Wilton carpet. All of the positions were vacant at the moment other than that of the helmsman on duty who sat, staring dutifully ahead, with his fingers resting lightly on the spokes of his steering wheel.

"Officers all below," said Alec. "Chatting up the first class passengers as always. Praise be I have my engines to look after so I don't have to join them. I say, let me show you around the engine room, I think you'll enjoy that. Just bung your case into nav's cubby, all the room in the world in there."

The navigator might not think so;

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the room was scarcely larger than a phone box and Gus had trouble finding a free corner for his case. Then Alec opened a hatch and led him down a spiral staircase to the forehold where longshoremen were putting aboard the last of the luggage, suitcases and great steamer trunks, lashing them into place with netting. A narrow walkway was left that they followed down the length of the vessel towards the stern.

"Passenger deck is one deck up but we can avoid them by going this way." Voices could be heard dimly above them accompanied by the lively strains of a merrily playing band.

"It sounds like a ten-piece brass band up there—don't tell me you ship all of them along, too?"

"Only in the ethereal sense, tape recordings you know. Have to watch the gross weight, the ruddy thing runs over one hundred tons before she gets airborne."

"I seem to have noticed little concern for weight up until now."

"You can say that again—or tell it to the Board of Governors if you will. In the Cunard tradition, they insist. If we stripped off all the chrome and brass and teak we could get another hundred passengers aboard."

"Though not in the same comfort. Perhaps they want quality not quantity?"

"There is that. Not my worry. Here we go, into this lift, a tight fit for two so try to think small." It operated automatically; the door closed and they rose smoothly at the touch of the button. "Wing is right on top of the body and this saves a climb."

They emerged inside a low-ceilinged passage that ran transverse to the length of the ship, with heavy doors sealing each end, knobs and indicator lights set into their frames. The engineer turned right and actuated the controls so the door there swung open to disclose a small room little bigger than the lift they had just quitted.

"Air lock," he said as the door behind them closed and another before them opened. "No point in pressurizing the engine rooms so we do this instead. Welcome to the portside engine room of the *Queen Elizabeth* where I rule supreme."

This rule was instantly challenged by a rating in a soiled white boilersuit who saluted indifferently then shook his thumb gloomily over his shoulder.

"Still at it, sir, fueling, topping up the bunkers they say."

"My orders were to have it done by ten."

"And that I've told them, sir," spoken with such an air of infinite sadness as though all the woes of the ages rode the man's thin shoulders.

"Well, they'll hear them again," said the engineer and added a score of colorful oaths that indicated both his military as well as his nautical background. He stamped over to a

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large hinged plate in the floor, unlocked the handles that secured it and threw it open. The water was a good twenty feet below as he seized the edge of the opening and popped his head and half of his upper body down through it so he hung upside down. "Ahoy the barge," he bellowed.

Gus knelt at the opposite side where he had a perfect view of the proceedings. A hulking barge with a pumping station at one end was tied up against the hull of the *Queen Elizabeth.* Great pipes snaked up from it to valves inset in the ship's side, the last of which was even then being disconnected. As it came away a great burst of black coal dust sullied the side of the leviathan of the air and the first engineer's comments entertained an even more colorful content. But as soon as all the pipes were away and the valves sealed, hoses were brought into play and within moments the hull was pristine again.

Alec pulled himself back inside with a victorious gleam in his eye—then sprang forward to the engine room telegraph as its bell rang twice and the brass indicator arm moved all around the face then returned to *warm engines.*

"Port, one," Alec called out. "Butane inlet valves."

"Aye, aye," the rating answered and the two men were instantly involved in the complex task.

Gus knew the theory of course, but he had never seen one of these giant engines in operation before. He was aware that each of the hulking turboprop engines, only a fraction of which protruded up through the bottom of the wing that was the floor here, produced 5,700 horsepower. First butane was admitted as an electric motor started the great shaft spinning with a muffled roar. Now the burning gas spun the turbine blades, faster and faster, until the desired temperature and pressures had been reached.

Alec tapped a dial and seemed satisfied, so he cut off the butane flow while at the same instant turned on the pump that blew the tiny particles of pulverized coal into the engine, where it burnt instantly and hotly. The great machine trembled and rumbled with restrained power as he adjusted the controls so it idled smoothly.

"I'll be down here until well after we're airborne, still have to fire up the starboard lot. Why don't you go back to the bridge, I'll phone through and tell them you are on the way up."

"Surely that would be an interference?"

"Not a bit of it. For every question you ask about this airborne Moby Dick they'll have a dozen about your transatlantic pipe. Get along now."

The engineer was not far wrong for the captain himself, Wing Commander Mason, met Gus and insisted he remain. The bridge was quiet, commands were issued in a re-

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strained manner and obeyed with alacrity, so it appeared that all the excitement was outside. The dockside crowd was waving and cheering, boat whistles blowing, until just on the stroke of midday the lines were cast off and the tugs nosed the ponderous airship away from the shore and out into the channel. Mason, who was young for a Cunard captain but who had grown a full beard to fit the accepted image, was proud of his charge.

"Waterline weight 198,000 pounds, Mr. Washington, 240 feet from stem to stern, 72 feet from the bottom of the step to the lookout's position top of the central tail fin. An exercise in superlatives, and all of them truthful I must admit. We have a 2,000 horsepower turbine in the tail that does nothing more than pump air for the boundary layer control and deflected slipstream, increases our lift to triple that of an ordinary wing. Why we'll be airborne at 50 miles an hour and inside 400 feet. Spray-suppressor grooves on both sides of the hull keep down the flying scud and smooth the sea for us. Now, if you will excuse me."

The tugs cast off, the helmsman spun the wheel to line the ship up for the takeoff, then disengaged his controls so the captain had command. Hooting police boats had cleared the harbor of small craft. Steadying the airborne tiller with his left hand the captain rang for *full ahead* with his right. A faint vibration in the deck could be felt as the turbines howled up to top speed and the *Queen Elizabeth* slipped forward over the water, faster and faster. The transition was so smooth that there was no distinction between being waterborne and airborne. In fact the very presence of this juggernaut of the airways was so solid and reassuring that it appeared as though instead of the ship rising the city outside had dropped away from them, shrinking at the same time to the size of a model, then tipping on its side as the ship began a slow turn to the west. Below them now the Isle of Wight slipped by, an unimportant green scrap of flotsam in the sparkling ocean, then they were out over the Channel with England contracting and vanishing under their starboard wing. Gus picked up his case and slipped below, happy to have shared this moment of triumph with these furrowers of a new and dimensionless sea.

A short corridor led aft to the Grand Saloon where the passengers were seeing and being seen. They sat at the tables, admired the view from the great circular ports, and gave the bar a brisk business. The room was not as spacious as its title indicated but the dark, curved ceiling gave an illusion of size with its twinkling stars and drifting clouds projected there by some hidden device.

Gus worked his way through the crowd until he caught the eye of a porter who led him to his cabin. It was tiny but complete and he dropped into the armchair with re-

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lief and rested, looking out of the porthole for a while. His bags that were labeled *cabin* were there and he knew that there were other papers in them that he should attend to. But for the moment he sat quietly, admiring the simplicity and beauty of the cabin's construction—it *was* an original Picasso lithograph on the wall—and the way the chair and desk would fold and vanish at night so the bunk could be opened. Eventually he yawned, stretched, opened his collar, opened his case and set to work.

When the gong sounded for luncheon he ignored it but sent instead for a pint of draught Guinness and a plowman's lunch of bread, cheese, and pickles. On this simple fare he labored well and by the time the gong sounded again, this time for dinner, he was more than willing to put his work away and join his fellow man. Even though it was a fellow woman who shared his table at the first seating, a lady of advanced years, very rich though of lowly antecedents. Both of these could be read easily into her jewelry and her vowels so that, eating swiftly, Gus returned to his cabin.

During his absence his bed had been opened and turned back, an electric hotwater bottle slipped between the sheets since the cabins were cooled to a refreshing sleeping temperature, and his pajamas lain across the pillow. Ten o'clock by his watch but—he spun it ahead five hours to New York time—they would be roused deucedly early. Three hundred miles an hour, a fifteen-hour flight—it might be a ten a.m. arrival local time but it would be five a.m. to his metabolism so he determined to get as much rest as possible. It was going to be a hectic day, week, month, year—hectic forever. Not that he minded. The tunnel was worth it, worth anything. He yawned, slipped between the covers and turned off the light. He left the portable curtains open so he could watch the stars moving by in stately splendor before he went to sleep.

The next sensation was one of struggling, drowning, not being able to breathe, dying, pinned down. He thrashed wildly, fighting against the unbreakable bands that bound him, trying to call out but finding his nose and mouth were covered.

It was not a dream. He had never smelled anything in a dream before, never had his nose assaulted in this manner, never had it been clogged with the cloying sweetness of ether.

In that instant he was wide awake, completely awake, and catching his breath, holding it, not breathing. In the Far West he had helped the surgeon many times, poured the ether into the cone on a wounded man's face, and had learned to hold his breath against the escaping, dizzying fumes. He did that now, not knowing what was happening but knowing that if he breathed in as much as one breath more he would lose consciousness.

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There was no light but as he struggled he became aware that at least two men were leaning their full weight on him, holding him down. Something cold was being fastened on his wrists while something else prisoned his ankles at the same time. Now the heavy figures simply held him while he writhed, keeping the ether rag to his face, waiting for him to subside.

It was torture. He fought on as long as he could before letting his struggles cease, went past the time where he wanted to breathe to the point where he needed to breathe to the excruciating, horrifying moment where he thought if he did not breathe he would die. With an almost self-destroying effort he passed this point as well and was sinking into a darker blackness when he felt the cloth being removed from his face at last.

First he breathed out the residual fouled air in his lungs, clearing his nostrils, and then, ever so slowly, despite the crying needs of his demanding body, he let a quiet trickle of air back into his lungs. Even as he did this he felt strong hands seize and lift him and carry him to the door which was opened a crack, then thrown wide so they could carry him through. There were dim night lights in the corridor and he slitted his eyes so they would appear closed and let his body remain completely limp despite the battering of the doorjamb as they rushed him through.

There was no one else in sight, no one to cry out to if that might have done any good. Just two men dressed completely in black with black gloves and black goggled masks over their faces that bulged out below. Two men, two rough strangers, hurrying him where?

To a waiting lift that streamed bright light when the door opened so that he closed his eyes at once. But he had recognized it, the lift from the hold up to the engine rooms that he had been in with the first engineer. What did this mean? He was jammed in, prevented from falling by the two assailants who pushed in with him so they rose silently in close, hoarse-breathing contact—while not a word was spoken. In a matter of less than a minute these two savage men had seized and bound him, theoretically rendered him unconscious and were now taking him some place with surely no good purpose.

The answer was quick in coming. The port engine room; they were retracing his visit of that morning. Into the air lock, close the one door while the other opened—to the accompanying snakelike hissing of an exhaust valve.

There was still nothing that Washington could do. If he struggled he would be rendered unconscious, for good this time. Though his nerves cried out for action, something to break this silence and captivity, he did nothing. His head was light by the time the inner door opened be-

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cause he had breathed as deeply as he could, hyperventilating his blood, getting as much oxygen into his bloodstream as he could. Because beyond the door was the unpressurized part of the flying ship where the air was just as thin as the 12,000 foot high atmosphere outside. Where a man simply breathed himself into gray unconsciousness and death. Was that what they had in mind? Would they leave him here to die? But why, who were they, what did they want?

They wanted to kill him. He knew that as soon as they dropped him to the cold metal of the deck and wrestled with the handles of the doorway beside him, the same one that Alec Durell had gone through in Southampton. But there he had a fall of twenty-five feet to an unwanted bath. Here there were 12,000 feet of fall to brutal death.

With a heave the door was thrown open and the three-hundred mile an hour slipstream tore through the opening, drowning out even the roar of the four great engines. It was then that Washington did what he knew he had to do.

He straightened his bent legs so they caught the nearest man behind the knees. For a brief instant the dark stranger hung there, arms flailing wildly before vanishing through the opening into the frigid night outside.

Gus did not wait until the other had gone but was wriggling across the floor to the alarm of a fire box, struggling to his feet and butting at it with his head until he felt the glass break and slice into his skin. Turning to face the remaining man, swaying as he did so.

There is no warning to anoxia, simply a slide into unconsciousness then death. He had the single thought that the bulbous mask must contain an oxygen tank or his assailant would be falling, too. He must stay awake. Fight. Unconscious, he would be dragged to the opening and dispatched into the night like the other man.

His eyes closed and he slid slowly down and sprawled, oblivious, on the deck.

V.

"A fine sunny morning, sir, bit of cloud about but nothing to really speak of."

The steward flicked back the curtain so that a beam of molten sunlight struck into the cabin. With professional skill he pulled open the drawer on the night table and put the tray with the cup of tea upon it. At the same time he dropped the ship's newspaper onto Washington's chest so that he awoke and blinked his eyes open just as the door closed silently behind the man. He yawned as the paper drew his attention so that he glanced through the headlines. HUNDREDS FEARED DEAD IN PERUVIAN EARTHQUAKE. SHELLING REPORTED AGAIN ALONG THE RHINE.

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NEW YORK CITY WELCOMES CAESAR CHAVEZ. The paper was prepared at the line's offices in New York, he knew that, then sent by radiocopy to the airship. The tea was strong and good and he had slept well. Yet there was a sensation of something amiss, a stiffness on the side of his face and he had just touched it and found a bandage there when the door was thrown open and a short, round man dressed in black and wearing a dog collar was projected through the doorway like a human cannonball, with Wing Commander Mason close behind *him.*

"Oh my goodness, goodness gracious," said the spherical man, clasping and unclasping his fingers, touching the heavy crucifix he wore about his neck, then tapping the stethoscope he wore over it as though unsure whether God or Aesculapius would be of most help. "Goodness! I meant to tell the steward, dozed off, thousand pardons. Best you rest, sure of that, sleep the mender—for you not me, of course. May I?" Even as he spoke the last he touched Gus's lower eyelid with a gentle finger and pulled it down, peering inside with no less concern and awe than he would have if the owner's eternal soul had rested there.

From confusion Gus's thoughts skipped instantly to dismay, followed thereafter by a sensation of fear that sent his heart bounding and brought an instant beading of perspiration to his brow. "Then it was no dream, no nightmare," he breathed aloud. "It really happened."

The ship's commander closed the door behind him and, once secrecy was assured, he nodded gravely.

"It did indeed, Captain Washington. Though as to what happened we cannot be sure and it is my fondest wish that you enlighten me, if you can, as soon as possible. I can tell you only that the fire alarm sounded in the port engine room at 0011 hours Greenwich Mean Time. The first engineer, who was attending an engine in the starboard engine room *at the time, responded instantly. He* reports he found you alone and unconscious on the deck, dressed as you are now, with lacerations on your face, lying directly below the fire alarm. Pieces of glass in your wounds indicate you set off the alarm with your head and this was necessitated by the fact that your ankles and wrists were secured by handcuffs. An access door in the deck nearby was open. That is all we know. The engineer, who was wearing breathing equipment, gave you his oxygen and pulled you from the room. The Bishop of Botswana, this gentleman here, who is a physician, was called and he treated you. The manacles were cut from you and, under the bishop's direction, you were permitted to sleep. That is all we know. I hope that you will be able to tell us more."

"I can," Gus said, and his voice was hoarse. The two intent men then

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saw his calm, almost uncomprehending expression change to one that appeared to be that of utter despair, so profound that the priestly physician sprang forward with a cry only to be restrained by the raised hand of his patient who waved him back, at the same time drawing in a deep breath that had the hollow quality of a moan of pain, then exhaling it in what could only be a shuddering sigh.

"I remember now," he said. "I remember everything. I have killed a man."

There was absolute silence as he spoke, haltingly at first as he attempted to describe his confusion upon awakening in distress, faster and faster as he remembered the struggle in the dark, the capture, the last awful moments when another had vanished into eternity and the possibility of his own death had overwhelmed him. When he had done there were tears in the bishop's eyes, for he was a gentle man who had led a sheltered life and was a stranger to violence, while next to him the captain's eyes held no tears but instead a look of grim understanding.

"You should not blame yourself, there should be no remorse," Wing Commander Mason said, almost in the tones of a command. "The attempted crime is unspeakable. That you fought against it in self-defense is to be commended not condemned. Had I been in the same place I hope my strength of endeavor and courage would have permitted me to do the same."

"But it was I, not you, Captain. It is something I shall never forget, it is a scar I shall always carry."

"You cannot blame yourself," said the bishop, at the same time fumbling for his watch and Gus's wrist in sudden memory of his medical capacity.

"It is not a matter of blame but rather one of realization. I have done a terrible thing and the fact that it appears to be justified makes it none the less terrible."

"Yes, yes, of course," said Wing Commander Mason, a little gruffly, tugging at his beard at the same time. "But I am afraid we must carry this investigation somewhat further. Do you know who the men were—and what their possible motive might be?"

"I am as mystified as you. I have no enemies I know of."

"Did you note any distinguishing characteristics of either of them? Some tone of voice or color of hair?"

"Nothing. They were dressed in black, masked, wore gloves, did not speak but went about this business in complete silence."

"Fiends!" the bishop cried, so carried away in his emotions that he crossed himself with his stethoscope.

"But, wait, wait, the memory is there if I can only grasp it. Something, yes—a mark, blue, perhaps a tattoo of some kind. One of the men, it was on his wrist, almost under my

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nose where he held me, revealed when his glove moved away from his jacket, on the inner side of his wrist. I can remember no details, just blue of some kind."

"Which man?" asked the captain. "The survivor or the other?"

"That I don't know. You can understand this was not my first concern."

"Indeed. Then there is a fifty-fifty chance that the man is still aboard—if he did not follow his accomplice through the opening. But by what excuse can we examine the wrists of the passengers? The crew members are well known to us but—" He was silent on the instant, struck by some thought that darkened his face and brought upon it a certain grimness unremarked before. When he spoke again it was in the tones of absolute command.

"Captain Washington, please remain here quietly. The doctor will tend your needs and I ask you to do as he directs. I will be back quite soon."

He was gone without any more explanation and before they could request one. The bishop examined Washington more thoroughly, pronounced him fit, though exhausted, and recommended a soothing draught which was refused kindly but firmly. Washington for his part lay quietly, his face set, thinking of what he had done and of what his future life might be like with a crime of this magnitude in his memory. He would have to accept it, he realized that, and learn to live with it. In the minutes that he lay there, before the door opened again, he had matured and grown measurably older so that it was almost a new individual who looked up when the captain entered for the second time. There was a bustle behind him as the first engineer, Alec, and the second officer came in, each holding firmly to the white-clad arm of a cook.

He could be nothing else, a tall and solid man all in white, chef's hat rising high on his head, sallow skinned and neat moustachioed with a look of perplexity on his features. As soon as the door had been closed, the tiny cabin was crowded to suffocation with this mixed company, the captain spoke.

"This is Jacques, our cook, who has served with this ship since her commissioning and has been with the Cunard ten years or more. He knows nothing of the events of last night and is concerned now only with the croissants he left to burn in the oven. But he has served me many times at table and I do recall one thing."

In a single swift motion the captain seized the cook's right arm, turning it outwards and pulling back his coat. There, on the inside of his forearm and startlingly clear against the paleness of his skin, was a blue tattoo of anchors and ropes, trellised flowers and recumbent mermaids. Washington saw it and saw more as memory clothed the man with black

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instead of white, felt the strength of gloved hands again and heard the hoarseness of his breathing. Despite the bishop's attempt to prevent him he rose from the bed and stood facing the man, his face mere inches away from the other's.

"This is the one. This is the man who attempted to kill me."

For long seconds the shocked expression remained on the cook's features, a study in alarm, confusion, searching his accuser's face for meaning while Washington stared grimly and unswervingly into the other's eyes as though he were probing his soul. Then the two officers who held the man felt his arms tremble, felt his entire body begin to shake as despair seized him and replaced all else, so that instead of restraining him they found they had to support him, and when the first words broke from his lips they released a torrent of others that could not be stopped.

"Yes, I . . . I was there, but I was forced, not by choice, dear God as a witness not by choice. *Sacré Dieu!* And remember, you fell unconscious, I could have done as I had been bid, you could not have resisted, I saved your life, left you there. Do not let them take mine, I beg of you, it was not by choice that I did any of this—"

In his release it all came out, the wretched man's history since he had first set foot in England twenty years previously, as well as what his fate had been since. An illegal émigré, helped by friends to escape the grinding unemployment of Paris, friends who eventually turned out to be less than friends, none other than secret agents of the French crown. It was a simple device, commonly used, and it never failed. A request for aid that could not be refused—or he would be revealed to the English authorities and jailed, deported. Then more and more things to do while a record was kept of each, and they were illegal for the most part, until he was bound securely in a web of blackmail. Once trapped in the net he was rarely used after that, a sleeper as it is called in the filthy trade, resting like an inactivated bomb in the bosom of the country that had given him a home, ready to be sparked into ignition at any time. And then the flame.

An order, a meeting, a passenger on this ship, threats and humiliations as well as the revelation that his family remaining in France would be in jeopardy if he dared refuse. He could not. The midnight meeting and the horrible events that followed. Then the final terrible moment when the agent had gone and he knew that he could not commit this crime by himself.

Washington listened and understood, and it was at his instruction that the broken man was taken away—because he understood only too well. It was later, scant minutes before the flying ship began her final approach to the Narrows and a land-

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ing in New York Harbor that the captain brought Washington the final report.

"The other man is the real mystery, though it appears he was not French. A professional at this sort of thing, no papers in his luggage, no makers' marks on his clothes, an absolute blank. But he was British, everyone who spoke to him is sure of that, and had great influence or he would not be aboard this flight. All the details have been sent to Scotland Yard and the New York Police are standing by now at the dock. It is indeed a mystery. You have no idea who your enemies might be?"

Washington sealed his last bag and dropped wearily into the chair.

"I give you my word, Captain, that until last night I had no idea I had any enemies, certainly none who could work in liaison with the French secret service and hire underground operatives." He smiled wryly. "But I know it now. I certainly know it now."

VI.

A truck had gone out of control on Third Avenue and, after caroming from one of the elevated railway pillars, mounting the curb and breaking off a water hydrant, it had turned on its side and spilled its cargo out into the street. This consisted of many bundles of varicolored cloth which had split and spread a gay bunting in all directions. The workings of chance had determined that the site of the accident could not have been better chosen for the machinations of mischief, or more ill chosen for the preserving of law and order, for the event had occurred directly in front of an Iroquois bar and grill.

The occupants of the bar now poured into the street to see the fun, whooping happily through the streaming water and tearing at the bundles to see what they contained. Most of the copper-skinned men were bare above the waist, it being a warm summer day, clad only in leggings and moccasins below with perhaps a headband and feather above. They pulled out great streamers of the cloth and wrapped it about themselves and laughed uproariously while the dazed truck driver hung out of the window of his cab above and shook his fist at them.

The fun would have ended with this and there would have been no great mischief done if this establishment, The Laughing Water, had not been located just two doorways away from Clancy's, a drinking palace of the same order that drew its custom solely from men of Hibernean ancestry. This juxtaposition had caused much anguish to the police and the peace of the area in the past and was sure to do so in the future, and in fact promised to accomplish the same results now in the present.

The Irishmen, hearing the excitement, also came out into the street and stood making comments and pointing and perhaps envying

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the natural exuberance of the Indians. The results were predictable and within the minute someone had been tripped, a loud name had been called, blows exchanged and a general melee resulted. The Iroquois, forced by law to check tomahawks and scalping knives at the city limits, or leave them at home if they were residents, found a ready substitute in the table knives from the grill. The Irish, equally restricted in the public display of shillelaghs, and blackthorn sticks above a certain weight, found bottles and chair legs a workable substitute and joined the fray. War whoops mixed with the names of saints and the Holy Family as they clashed.

There were no deaths or serious maimings, since the object of the exercise was pleasure, but there were certainly broken heads and bones and at least one scalp taken, the token scalp of a bit of skin and hair. The roar of a passing el train drowned the happy cries and when it had rumbled into oblivion police sirens took its place. Spectators stood at a respectable distance and enjoyed the scene while barrow merchants, quick to seize the opportunity, plied the edge of the crowd selling refreshments. It was all quite enjoyable.

Ian Macintosh found it highly objectionable, not the sort of thing at all that one would ever see on the streets of Campbelltown, or in Machrihanish. People who gave Highlanders a bad name for fighting and carousing ought to see the Colonies first. He sniffed loudly, an act easily done since his sniffer was a monolithic prow seemingly designed for that or some more important function. It was the dominating element of Macintosh's features, nay of his entire body for he was slight and narrow and dressed all in gray as he thought this only properly fitting, and his hair was gray while even his skin, when not exposed to the elements for too long a time, also partook of that neutral color. So it was his nose that dominated and due to its prominence, and to his eager attention to details and to bookkeeping, his nickname of "Nosey" might seem to be deserved, though it was never spoken before his face, or rather before his nose.

Now he hurried by on Forty-second Street, crossing Third Avenue and sniffing one parting sniff in the direction of the melee. He pressed on through the throng, dodging skillfully even as he drew out his pocket watch and consulted it. On time, of course, on time. He was never late. Even for so distasteful a meeting as this one. What must be done must be done. He sniffed again as he pushed open the door of the Commodore Hotel, quickly before the functionary stationed there could reach it, driving him back with another sniff in case he should be seeking a gratuity for a service not performed. It was exactly two o'clock when he entered and he took some grudging pleasure from the fact that Washington was already there. They

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shook hands, for they had met often before, and Macintosh saw for the first time the bandages on the side of the other's face that had been turned away from him until then. Gus was aware of the object of the other's attention and spoke before the question could be asked.

"A recent development, Ian. I'll tell you in the cab."

"No cab. Sir Winthrop is sending his own car, as well he might, though it's no pleasure riding in a thing that color."

"A car need not necessarily be black," Gus said, amused, as they went up the steps to the elevated Park Avenue entrance where the elongated yellow form of the Cord Landau was waiting. Its chrome exhausts gleamed, the wire wheels shone, the chauffeur held the door for them. Once inside, with the connecting window closed, Gus explained what had happened on the airship. "And that's the all of it," he concluded. "The cook knows nothing more and the police do not know the identity of his accomplice, or who might have employed him."

Macintosh snorted loudly, a striking sound in so small an enclosure, then patted his nose as though commending it for a good performance. "They know who did it and we know who did it, though proving it is another matter."

"But I'm sure *I* don't know." Gus was startled by the revelation.

"You're an engineer, Augustine, and more of an engineer than I'll ever be, but you've had your head buried in the tunnel and you've no' been watching the business end, or the Stock Exchange, or the Bourse."

"I don't follow."

"Then try this if you will. If someone tries hurting you it is time to see whom you might have been hurting, too. People who might have a lot of money but might see their shares slipping a wee bit. People who look to the future and see them slipping a good deal more and intend to do something about it now. People with contacts on an international level who can reach the right people in the Sûreté who are always willing to jump at a chance to make mischief for Britain. And who might they be?"

"I have no idea."

"You're being naïve, you are!" Macintosh laid his finger along his nose, which hid this digit and a good part of his hand as well, in a conspiratorial gesture. "Now I ask you, if we be under the water, who be over it?"

"Airships, but the tunnel offers them no competition. And ships upon the ocean, but—" His voice stopped and his features wore a startled look. Macintosh smiled a wintry smile in return.

"No names, no pack drill, and the culprits will be hard to find I warrant. But a command may be spoken, half in jest perhaps—and I ask you to remember Thomas Becket!—an order relayed, an order given, an

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ambitious man, money changes hands. I shall not spell it out but I can and do suggest that you beware in the future."

The car stopped then before one of the taller buildings in Wall Street and they emerged with Gus in a speculative state of mind. There was more to constructing a tunnel than digging a hole he realized, and apparently assassins could now be assumed to be an occupational hazard. Along with Boards of Directors. But he was prepared for the latter at least, had been preparing for this day for the past week, bolstering his facts, pinning down his figures. Taking a chance, a leap into the darkness that had been troubling him ever since he had first realized what must be done. His career rested upon the outcome of today's meeting and rightly enough it concerned him deeply. But, since the previous night when he had been face to face with a far more literal and final leap into the darkness, his will had been strengthened. What must be done must be done—and he would do it.

Sir Winthrop he knew, and shook his hand, and was introduced to the other members of the Board whom he was acquainted with only by name and reputation. Self-made men all of them, solid and sure of themselves, twenty-one different individuals who blended into one as he looked. One man, one body of men, whom he had to convince.

As he seated himself at the place reserved for him at the long table he realized that the meeting had been in session for some time if the state of the ashtrays was any indication; since these men were experienced marksmen the spittoons showed no such evidence. This was clear proof that he had been deliberately invited to arrive after the proposals regarding his new status had been put before the Board. There were no echoes of discussion in the heavy drapes that framed the windows or in the rich cigar fragrance of the air, but some hint of differences of opinion could be detected in the rigid scowls and set faces of a few of the Board members. Obviously the unanimity of opinion did not exist here as it did on the Board in London; but Gus had expected this. He knew the state of mind of his fellow colonials and had marshaled his facts to override any objections.

"Gentlemen of the Board," said Sir Winthrop, "we have been discussing one matter for some time now, that is the possibility of my stepping down as chairman of this Board to be replaced by Captain Washington, who will also be in charge of the engineering of the tunnel here. This change has been forced upon us by the disastrous state of the finances of the entire operation, finances that must be mended if we are to have any operation at all. It was decided to postpone a vote upon this matter until the captain could be spoken to and inter-

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rogated. He is here. Ah, I see Mr. Stratton wishes to begin."

Mr. Stratton's lean figure rose from its chair like a vulture ascending, a jointed collection of black suiting and white skin with dark-set eyes and pointed accusing finger, an upsetting apparition at any time and even more so now as he rattled with anger.

"No good, no good at all, we can't have our firm represented by a man with the name of Washington, no not at all. As soon have Judas Iscariot as Board chairman, or Pontius Pilate, or Guy Fawkes—"

"Stratton, would you kindly confine yourself to the matter at hand and reserve the historical lecture for another time."

The speaker of these quiet but acidulous words lolled at ease in his chair, a short and fat roly-poly sort of man with a great white beard that flowed over his chest, a great black cigar that stuck up out of his mouth like a flagstaff—and a cold, penetrating eye that belied any impression of laxity or softness that the exterior might suggest.

"You'll hear me out, Gould, and stay silent. There are some things that cannot be forgotten—"

"There are some things that are better off forgotten," came the interruption again. "It is almost two hundred years now and you are still trying to fight the rebellion over again. Enough I say. Your ancestors were Tories, very nice for them, they picked the winning side. If they had lost we would be calling them traitors now and maybe George Washington would have had them shot the way they squeezed poor old German George to shoot him. Maybe you got guilt feelings about that, huh?, which is why you keep scratching all the time at this same itch. For the record I got ancestors, too, and one of them was involved, a Haym Solomon, poor fellow lost everything he had financing the revolution and ended up selling pickles out of a barrel on the east side. Does this bother me? Not a bit. I vote the straight Tory ticket now because that is the party of the big money and I got big money. Let bygones be bygones."

"Then you were as unlucky in your choice of ancestors as Washington was," Stratton snapped back, bristling and crackling with anger and shooting his cuffs in a manner which suggested that he wished there were some real shooting of certain people involved. "I wouldn't brag about it if I were you. In any case the public at large is not aware of your indecorous lineage whereas the name Washington has an ineradicable taint. The American public will rise in arms against anything connected with a name so odious."

"Yore full of hogwash, Henry," a leathery Texas voice drawled out from a large man far down the table who wore a wide-brimmed hat, despite the fact the others were all bareheaded. "In the west we have a hard job rememberin' where New England is much less the details of all

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your Yankee feudin'. If this engineer feller can sell the stock fer us, I say hire him and be done with it."

"Me, too," a deep voice boomed in answer from a copper skinned individual even further along the Board. "All that the Indians know is that all white men are no good. Too many of us were shot up before the Peace of 1860. If oil hadn't been discovered on Cherokee lands, I wouldn't be sitting here now. I say hire him."

There was more spirited crosstalk after this that was finally hammered into silence by the chairman's gavel. He nodded to Gus who rose and faced them all.

"What Mr. Stratton has to say is very important. If the name of Washington will do injury to the tunnel this fact must be taken into consideration, and if true I will withdraw at once from the position that is under discussion. But I feel, as others here apparently do as well, that old hatreds are best forgotten in the new era. Since the original thirteen states attempted to form their own government and failed, this country has grown until now it numbers thirty-one states and the California Territory. Living in these states are the various Indian tribes who care little, as Chief Sunflower has told you, of our ancient squabbles. Also in these states are refugees from the Baltic Wars, Jewish refugees from the Russian pogroms, Dutch refugees from the Dike disaster, Swedish refugees from the Danish occupation, people from many different states and nations who also do not care about these same ancient squabbles. I say that they will be far more interested in the percentage of return upon their investment than they will in my grandfather's name. It is unimportant and not relevant at this time.

"What is important is the plan I have conceived that will attract investors, and it is my wish that you hear this plan before voting upon my qualifications for the position. You will be buying a pig in a poke if you do anything else. Let me tell you what I want to do, then, if you agree that my plans have merit, vote for them and not the individual who proposes them. If you think them bad then I am not the one you want and I will return to my tunnel in England and no more will be said on the subject."

"Now that's what I call plain talk. Let's hear the boy out."

There were cries of agreement at this proposal and Stratton's rattle of defiance was lost in the general approval. Gus nodded and opened his case and drew out the mass of papers he had so carefully prepared.

"Gentlemen, my only aim is to save the tunnel and this is the plan that I put before you. This is all I have come to do. If I can help by being a figurehead, then I shall climb up on the bowsprit of the corporate ship and suspend myself from it. I am an engineer. My fondest ambi-

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tion is to be part of the building of the transatlantic tunnel. The British Board of Directors feels that I can aid most by being in charge of the American end of the tunnel, so that the American public will see that this is an American enterprise as well. I do not wish to replace Mr. Macintosh but to aid him, so that we can pull in a double harness. I hope he will remain as my first assistant in all matters of construction and my equal if not my superior in the matter of supplies and logistics for he is an expert in these matters." A bugle-like sniff announced that this statement was not amiss in at least one quarter.

"In relation to this Board let my position be literally that of a figurehead—though I would suggest this intelligence be kept within this room. I am no financier and my hope is that Sir Winthrop will continue in his original function *pro tem* until the time arrives when he can fulfill it in the public eye as well. I wish to build this tunnel and build it well, and build it quickly so that a fair profit can be returned on investments. That is my prime function. Secondly, I must publicize this construction in such a manner that investors will flock to our banner and thrust dollars upon us in ever-growing sums."

"Hear, hear!" someone called out while another said, "And how will that be done?"

"In the following manner. We shall abandon the present technique of construction and proceed in a different, cheaper, faster way that will have a broader base in the economy. Which stirring up of the economy I believe was one of the motivating factors in the first place."

"Does Sir Isambard know of this?" Macintosh called out, his face flushed, the tin dark barrels of his nostrils aimed like mighty guns.

"To be very frank—he does not. Though we have discussed it many times in the past. His decision has been to continue the present slip casting technique until it proves impracticable, if ever, and only then to consider different methods of construction. I thought him wrong, but as long as I was subordinate there was nothing I could do. Now that I hope to assume what might be called an independent command I am exercising my judgment to make a change to a more modern, a more American technique, to—"

"To stab him in the back!"

"Nothing of the sort."

"Let him talk, Scotty," the Texan called out. "He's makin' sense so far."

He had their attention and at least the sympathy of some. Now if he could only convince them. There was absolute silence as Washington took a blueprint from his case and held it up.

"This is what we are doing now, building the tunnel by slip casting, what has been called the most modern technique. As the tunneling

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shield is pushed ahead and ground removed, this great metal tube is pushed along behind it. Reinforcing rods are put in place outside the tube and concrete is pumped in. The concrete sets, the tube is advanced again and the end result is a continuous tunnel that is cast in place. The shield moves ahead at a varying rate but never averaging more than thirty feet a day. Very impressive. Until you consider the width of the Atlantic.

"If this rate continues steadily—and we have no guarantee that it will plus plenty of suspicion it will not—we will reach the midpoint in the Atlantic at the same time, hopefully, as the British tunnel arrives, in something in the neighborhood of 105,000 days. That, gentlemen, is a bit over two-hundred years."

Rightly enough there was a murmur of dismay over this and some quick calculations on the scratch pads.

"The figure is a disheartening one I agree, and most investors care for a quicker return, but happily it is not the final one. What I suggest is that we replace the technique we are now using which will speed the process greatly, while at the same time giving a great lift to the American economy in all spheres; shipbulding, steel, engineering, and many more. And it will reduce the time needed for construction as well.

"Reduce it to about ten years' time."

Not surprisingly, there was instant consternation over this statement as well as excitement and one man's voice rose above the roar and spoke for them all.

"How, I want to know, just tell me how!"

The hubbub died away as Washington took a drawing from his case and unfolded it and held it up for their inspection.

"This is how. You will note that this is a section of tunnel some ninety feet in length and constructed of reinforced concrete. It contains two rail tunnels, side by side, and a smaller service tunnel below. This is what the tunnel we are driving now looks like. The smaller tunnel is known as an adit and is driven first. In this manner we can test the rock and soil that we shall be digging through and know what problems face the larger tunnels. These tunnels are driven side by side and are connected at intervals by cross chambers. All in all a complex and technical manner to tunnel and we should be very happy with the thirty feet a day we have been averaging. Except for the fact that we have thousands of miles to go. Therefore I suggest what may appear to be novel and untried, but let me assure you that this technique has been tried and found true in this country, in the tunnels under Delaware Bay and the Mississippi River and in other parts of the world such as Hong Kong Harbor.

"The technique is this: the tunnel is preformed and precast and built in

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sections ashore—then floated to the site and sunk. Built under the best conditions possible, tested for defects, left to cure and set, and only then allowed to become a part of the tunnel.

"Can you gentlemen visualize what this will mean? All along the Atlantic seaboard and in the Gulf of Mexico shipyards and newly constructed facilities will be prefabricating the sections—even in the Great Lakes and on the Saint Lawrence River the yards will be busy. Vast amounts of steel and concrete will be needed almost at once—it goes without saying that those who have invested in steel and concrete stand to make a good deal of money. Contracts will be let to anyone who can prove he will supply the goods. The economy of this nation cannot help but be vitalized by an economic injection of such magnitude. The tunnel will be built, and in the building thereof this great country of ours will be built anew!"

There were cheers at that, for Gus had fired them with his own enthusiasm and they believed him. There was even more scribbling on pads and quick looks at the *Wall Street Journal* to see what the condition of steel and concrete stocks were; already some of the men were using their pocket telegraphs to get in touch with their brokers. A feeling of new life had swept the room and there were very few, one individual in particular, who did not share in the overriding enthusiasm. When the noise had died down Macintosh spoke.

"Sir Isambard must be notified of this suggestion. Nothing can be done without his approval."

Loud catcalls mixed with boos greeted this suggestion and it was Sir Winthrop who spoke to the point.

"I do not think that will be necessary. The financing of the tunnel is in trouble or this special meeting would not have been held, and Captain Washington would not have been sent here in his present capacity. He has a free hand from London, you must remember that, he has a free hand. If the financial obligations are not met on this side of the Atlantic, then there will be no tunnel at all. If this change in technique will assure success, and I have no reason to believe differently, then we must adopt it. Nothing else is possible."

There were questions then, all of them answered with precision and facts, as well as a small amount of opposition mostly in the form of the gentleman from New England.

"Mark my words—it will be a disaster. A name like Washington can only bring the worst of results—"

He was shouted into silence and there was at least one cry of "Take his scalp!", which would be singularly difficult since the hair that presumably once had resided there had long vanished, but the utterance of which made him clap his hand to his head and sit down with great alacrity so that this voice of dissent

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from the general opinion was silenced and there were no others to occupy its place. A verbal vote was taken and carried with a good deal of cheering and only when silence reigned again did Macintosh stand, shaking with anger, and address his closing remarks to them all.

"Then so be it, I'll not argue. But I consider this small repayment to the great man who conceived and designed this tunnel." He stabbed out a damning finger. "A man who took you into his home, Augustine Washington, to whose daughter I do believe you are engaged. Have you ever thought what effect this decision will have on that young lady?"

The room was silent at this for, in his enthusiasm to defend his employer and friend, Macintosh had overstepped the bounds of polite society and had entered the distasteful areas of personalities and abuse. He must have realized this even as the words left his mouth because he blanched a grayer gray and started to sit, then rose again as Washington turned to face him. The American's features were set and firm, but an observant eye would have noticed how all the tendons and veins rose up from the back of his hands and how bloodless his knuckles were where he clenched them. He spoke.

"I am glad this was mentioned, since it is sure to be questioned by someone else at some later date. Firstly, I still admire and respect Sir Isambard as my mentor and employer and have nothing but the greatest respect for him. In his sagacity he bids us wait to use this new tunneling technique and we would wait had we but the time and the money. We do not. So we will proceed with a plan that has his approval at least in theory, if not in application, at the present time. I wish him nothing but good will and even understand his attitude towards me. He who stands alone on Olympus does not wish to make room for others. And he does stand alone as the engineer and builder of our age. When my new role in the American developments was voted upon in London he felt he had been done a personal injury and I can understand that, too. He has forbidden me his house and I do not blame him in any way because according to his lights he is correct. He has also insisted that the engagement between myself and his daughter be terminated, and this has been done. I will not discuss my personal feelings with you gentlemen other than I wish it were not so. But it is. In one sense it is a good thing because it frees me to make the correct decision, for the tunnel if not for myself.

"The money shall be raised and the tunnel shall be built in the manner I have outlined."

TO BE CONTINUED

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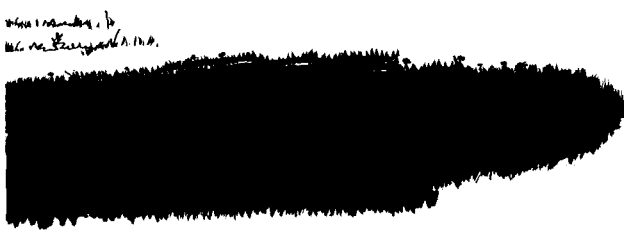
wings of victory

Simply because no terrestrial animal can achieve such performance does not prove an alien life form can't . . .

POUL ANDERSON



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Our part in the Grand Survey had taken us out beyond the great suns Alpha and Beta Crucis. From Earth we would have been in the constellation Lupus. But Earth was 278 light-years remote, Sol itself long dwindled in invisibility, and stars drew strange pictures across the dark.

After three years we were weary and had suffered losses. Oh, the wonder wasn't gone. How could it ever go—from world after world after world? But we had seen so many, and of those we had walked on, some were beautiful and some were terrible and most were both—even as Earth is—and none were alike and all were mysterious. They blurred together in our minds.

It was still a heart-speeding thing to find another sentient race, actually more than to find another planet colonizable by man. Now Ali Hamid had perished of a poisonous bite a year back, and Manuel Gonsalves had not yet recovered from the skull fracture inflicted by the club of an excited being at our last stop. This made Vaughn Webner our chief xenologist, from whom was to issue trouble.

Not that he, or any of us, wanted it. You learn to gang warily, in a universe not especially designed for you, or you die; there is no third choice. We approached this latest star because every G-type dwarf beckoned us. But we did not establish orbit around its most terrestroid attendant until neutrino analysis had verified that nobody in the system employed atomic energy. And we exhausted every potentiality of our instruments before we sent down our first robot probe.

The sun was a G9, golden in hue, luminosity half of Sol's. The world which interested us was close enough in to get about the same irradiation as Earth. It was smaller, surface gravity 0.75, with thinner and drier atmosphere. However, that air was perfectly breathable by humans, and bodies of water existed which could be called modest oceans. The globe was very lovely where it turned against star-crowded night, blue, tawny, rusty-brown, white-clouded. Two little moons skipped in escort.

Biological samples proved that its life was chemically similar to ours. None of the microorganisms we cultured posed any threat that normal precautions and medications could not handle. Pictures taken at low altitude and on the ground showed woods, lakes, wide plains rolling toward mountains. We were afire to set foot there.

But the natives—

You must remember how new the hyperdrive is, and how immense the cosmos. The organizers of the Grand Survey were too wise to believe that the few neighbor systems we'd learned something about gave knowledge adequate for devising doctrine. Our service had one law, which was its proud motto: "We come as friends." Otherwise each crew was free to work out its own

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procedures. After five years the survivors would meet and compare experiences.

For us aboard the *Olga,* Captain Gray had decided that, whenever possible, sophonts should not be disturbed by preliminary sightings of our machines. We would try to set the probes in uninhabited regions. When we ourselves landed, we would come openly. After all, the shape of a body counts for much less than the shape of the mind within. Thus went our belief.

Naturally, we took in every datum we could from orbit and upper-atmospheric overflights. While not extremely informative under such conditions, our pictures did reveal a few small towns on two continents—clusters of buildings, at least, lacking defensive walls or regular streets—hard by primitive mines. They seemed insignificant against immense and almost unpopulated landscapes. We guessed we could identify a variety of cultures, from Stone Age through Iron. Yet invariably, aside from those petty communities, settlements consisted of one or a few houses standing alone. We found none less than ten kilometers apart; most were more isolated.

"Carnivores, I expect," Webner said. "The primitive economies are hunting-fishing-gathering, the advanced economies pastoral. Large areas which look cultivated are probably just to provide fodder; they don't have the layout of proper farms." He tugged his chin. "I confess being puzzled as to how the civilized . . . well, let's say the 'metallurgic' people, at this stage . . . how they manage it. You need trade, communication, quick exchange of ideas, for that level of technology. And if I read the pictures aright, roads are virtually nonexistent, a few dirt tracks between towns and mines, or to the occasional dock for barges or ships—Confound it, water transportation is insufficient."

"Pack animals, maybe?" I suggested.

"Too slow," he said. "You don't get progressive cultures when months must pass before the few individuals capable of originality can hear from each other. The chances are they never will."

For a moment the pedantry dropped from his manner. "Well," he said, "we'll see," which is the grandest sentence that any language can own.

We always made initial contact with three, the minimum who could do the job, lest we lose them. This time they were Webner, xenologist; Aram Turekian, pilot; and Yukiko Sachansky, gunner. It was Gray's idea to give women that last assignment. He felt they were better than men at watching and waiting, less likely to open fire in doubtful situations.

The site chosen was in the metallurgic domain, though not a town. Why complicate matters unnecessarily? It was on a rugged upland, thick

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forest for kilometers around. Northward the mountainside rose steeply until, above timberline, its crags were crowned by a glacier. Southward it toppled to a great plateau, open country where herds grazed on a reddish analog of grass or shrubs. Maybe they were domesticated, maybe not. In either case, probably the dwellers did a lot of hunting.

"Would that account for their being so scattered?" Yukiko wondered. "A big range needed to support each individual?"

"Then they must have a strong territoriality," Webner said. "Stand sharp by the guns."

We were not forbidden to defend ourselves from attack, whether or not blunders of ours had provoked it. Nevertheless the girl winced. Turekian glanced over his shoulder and saw. That, and Webner's tone, made him flush. "Blow down, Vaughn," he growled.

Webner's long, gaunt frame stiffened in his seat. Light gleamed off the scalp under his thin hair as he thrust his head toward the pilot. "What did you say?"

"Stay in your own shop and run it, if you can."

"Mind your manners. This may be my first time in charge, but I *am*—"

"On the ground. We're aloft yet."

"Please." Yukiko reached from her turret and laid a hand on either man's shoulder. "Please don't quarrel . . . when we're about to meet a whole new history."

They couldn't refuse her wish. Tool-burdened coverall or no, she remained in her Eurasian petiteness the most desired woman aboard the *Olga*; and still the rest of the girls liked her. Gonsalves's word for her was *"simpatico."*

The men only quieted on the surface. They were an ill-assorted pair, not enemies—you don't sign on a person who'll allow himself hatred—but unfriends. Webner was the academic type, professor of xenology at the University of Oceania. In youth he'd done excellent field work, especially in the trade route cultures of Cynthia, and he'd been satisfactory under his superiors. At heart, though, he was a theorist, whom middle age had made dogmatic.

Turekian was the opposite: young, burly, black-bearded, boisterous and roisterous, born in a sealtent on Ganymede to a life of banging around the available universe. If half his brags were true, he was mankind's boldest adventurer, toughest fighter, and mightiest lover; but I'd found to my profit that he wasn't the poker player he claimed. Withal he was able, affable, helpful, well liked—which may have kindled envy in poor self-chilled Webner.

"O.K., sure," Turekian laughed. "For you, Yu." He tossed a kiss in her direction.

Webner unbent less easily. "What did you mean by running my own shop if I can?" he inquired.

"Nothing, nothing," the girl almost begged.

"Ah, a bit more than nothing,"

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Turekian said. "A tiny bit. I just wish you were less convinced your science has the last word on all the chances. Things I've seen—"

"I've heard your song before," Webner scoffed. "In a jungle on some exotic world you met animals with wheels."

"Never said that. Hm-m-m . . . make a good yarn, wouldn't it?"

"No. Because it's an absurdity. Simply ask yourself how nourishment would pass from the axle bone to the cells of the disk. In like manner—"

"Yeh, yeh. Quiet, now, please. I've got to conn us down."

The target waxed fast in the bow screen. A booming of air came faint through the hull plates and vibration shivered flesh. Turekian hated dawdling. Besides, a slow descent might give the autochthons time to become hysterical, with possibly tragic consequences.

Peering, the humans saw a house on the rim of a canyon at whose bottom a river rushed gray-green. The structure was stone, massive and tile-roofed. Three more buildings joined to define a flagged courtyard. These were of timber, topped by blossoming sod, long and low. A corral outside the quadrangle held four-footed beasts, and nearby stood a row of what Turekian, pointing, called overgrown birdhouses. A meadow surrounded the ensemble. Elsewhere the woods crowded close.

There was abundant bird or, rather, ornithoid life, flocks strewn across the sky. A pair of especially large creatures hovered above the steading. They veered as the boat descended.

Abruptly, wings exploded from the house. Out of its windows fliers came, a score or better, all sizes from tiny ones which clung to adult backs, up to those which dwarfed the huge extinct condors of Earth. In a gleam of bronze feathers, a storm of wingbeats which pounded through the hull, they rose, and fled, and were lost among the treetops.

The humans landed in a place gone empty.

Hands near side arms, Webner and Turekian trod forth, looked about, let the planet enter them.

You always undergo that shock of first encounter. Not only does space separate the new-found world from yours; time does, five billion years at least. Often you need minutes before you can truly see the shapes around, they are that alien. Before, the eye has registered them but not the brain.

This was more like home. Yet the strangenesses were uncountable.

Weight: three-fourths of what the ship maintained. An ease, a bounciness in the stride . . . and a subtle kinesthetic adjustment required, sensory more than muscular.

Air: like Earth's at about two kilometers' altitude. (Gravity gradient being less, the density drop-off above sea level went slower.) Crystalline vision, cool flow and

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murmur of breezes, soughing in the branches and river clangorous down in the canyon. Every odor different, no hint of sun-baked resin or duff, instead a medley of smokinesses and pungencies.

Light: warm gold, making colors richer and shadows deeper than you were really evolved for; a midmorning sun which displayed almost half again the diameter of Earth's, in a sky which was deep blue and had only thin streaks of cloud.

Life: wild flocks, wheeling and crying high overhead; lowings and cacklings from the corral; rufous carpet underfoot, springy, suggestive more of moss than grass though not very much of either, starred with exquisite flowers; trees whose leaves were green—from silvery to murky—whose bark—if it were bark—might be black, or gray, or brown, or white, whose forms were perhaps no odder to you than were palm, or gingko, if you came from oak and beech country, but which were no trees of anywhere on Earth. A swarm of midgelike insectoids went by, and a big coppery-winged "moth" leisurely feeding on them.

Scenery: superb. Above the forest, peaks shouldered into heaven, the glacier shimmered blue. To the right, canyon walls plunged roseate, ocher-banded, and cragged. But your attention was directed ahead.

The house was astonishingly big. "A flinking castle," Turekian exclaimed. An approximate twenty-meter cube, it rose sheer to the peaked roof, built from well-dressed blocks of granite. Windows indicated six stories. They were large openings, equipped with wooden shutters and wrought-iron balconies. The sole door, on ground level, was ponderous. Horns, skulls, and sculptured weapons of the chase—knife, spear, shortsword, blowgun, bow and arrow—ornamented the façade.

The companion buildings were doubtless barns or sheds. Trophies hung on them, too. The beasts in the corral looked, and probably weren't, mammalian. Two species were vaguely reminiscent of horses and oxen, a third kind of sheep. They were not many, could not be the whole support of the dwellers here. The "dovecotes" held ornithoids the size of turkeys, which were not penned but were prevented from leaving the area by three hawklike guardians. "Watchdogs," Turekian said of those. "No, watchfalcons." They swooped about, perturbed at the invasion.

Yukiko's voice came wistful from a receiver behind his ear: "Can I join you?"

"Stay by the guns," Webner answered. "We have yet to meet the owners of this place."

"Huh?" Turekian said. "Why, they're gone. Skedaddled when they saw us coming."

"Timid?" Yukiko asked. "That doesn't fit well with their being eager hunters."

"On the contrary, I imagine they're pretty scrappy," Turekian

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said. "They jumped to the conclusion we must be hostile, because they wouldn't enter somebody else's land uninvited unless they felt that way. Our powers being unknown, and they having the wife and kiddies to worry about, they prudently took off. I expect the fighting males—or whatever they've got—will be back soon."

"What are you talking about?" Webner demanded.

"Why . . . the locals." Turekian blinked at him. "You saw them."

"Those giant ornithoids? Nonsense."

"Hoy? They came right out of the house there!"

"Domestic animals." Webner's hatchet features drew tight. "I don't deny we confront a puzzle here."

"We always do," Yukiko put in.

Webner nodded. "True. Nevertheless, facts and logic solve puzzles. Let's not complicate our job with pseudo-problems. Whatever they are, the fliers we saw leave cannot be the sophonts. On a planet as Earth-like as this, aviform intelligence is impossible."

He straightened. "I suspect the inhabitants have barricaded themselves," he finished. "We'll go closer and make pacific gestures."

"Which could be misunderstood," Turekian said dubiously. "An arrow, or javelin, can kill you just as dead as a blaster."

"Cover us, Yukiko," Webner ordered. "Follow me, Aram. If you have the nerve."

He stalked forward, under the eyes of the girl. Turekian cursed and joined him in haste.

They were near the door when a shadow fell over them. They whirled and stared upward. Yukiko's indrawn breath hissed from their receivers.

Aloft hovered one of the great ornithoids. Sunlight struck through its outermost pinions, turning them golden. Otherwise it showed storm-cloud-dark. Down the wind stooped a second.

The sight was terrifying. Only later did the humans realize it was magnificent. Those wings spanned six meters. A muzzle full of sharp white fangs gaped before them. Two legs the length and well-nigh the thickness of a man's arms reached crooked talons between them. At their angles grew claws. In thrust after thrust, they hurled the creature at torpedo speed. Air whistled and thundered.

Their guns leaped into the men's hands. "Don't shoot!" Yukiko's cry came as if from very far away.

The splendid monster was almost upon them. Fire speared from Webner's weapon. At the same instant, the animal braked—a turning of quills, a crack and gust in their faces—and rushed back upward, two meters short of impact.

Turekian's gaze stamped a picture on his brain which he would study over and over and over. The unknown was feathered, surely warm-

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blooded, but no bird. A keelbone like a ship's prow jutted beneath a strong neck. The head was blunt-nosed, lacked external ears; fantastically, Turekian saw that the predator mouth had lips. Tongue and palate were purple. Two big golden eyes stabbed at him, burned at him. A crest of black-tipped white plumage rose stiffly above, a control surface and protection for the backward-bulging skull. The fan-shaped tail bore the same colors. The body was mahogany, the naked legs and claws yellow.

Webner's shot hit amidst the left-side quills. Smoke streamed after the flameburst. The creature uttered a high-pitched yell, lurched, and threshed in retreat. The damage wasn't permanent, had likely caused no pain, but now that wing was only half useful.

Turekian thus had time to see three slits in parallel on the body. He had time to think there must be three more on the other side. They weirdly resembled gills. As the wings lifted, he saw them drawn wide, a triple yawn; as the downstroke began, he glimpsed them being forced shut.

Then he had cast himself against Webner. "Drop that blaster, you clotbrain!" he yelled. He seized the xenologist's gun wrist. They wrestled. He forced the fingers apart. Meanwhile the wounded ornithoid struggled back to its companion. They flapped off.

"What're you doing?" Webner grabbed at Turekian.

The pilot pushed him away, brutally hard. He fell. Turekian snatched forth his magnifier.

Treetops cut off his view. He let the instrument drop. "Too late," he groaned. "Thanks to you."

Webner climbed erect. He was pale and shaken by rage. "Have you gone heisenberg?" he gasped. "I'm your commander!"

"You're maybe fit to command plastic ducks in a bathtub," Turekian said. "Firing on a native!"

Webner was too taken aback to reply.

"And you capped it by spoiling my chance for a good look at Number Two. I think I spotted a harness on him, holding what might be a weapon, but I'm not sure." Turekian spat.

"Aram, Vaughn," Yukiko pleaded from the boat.

An instant longer, the men bristled and glared. Then Webner drew breath, shrugged, and said in a crackly voice: "I suppose it's incumbent on me to put things on a reasonable basis, if you're incapable of that." He paused. "Behave yourself and I'll excuse your conduct as being due to excitement. Otherwise I'll have to recommend you be relieved from further initial-contact duty."

"*I* be relieved–?" Turekian barely checked his fist, and kept it balled. His breath rasped.

"Hadn't you better check the house?" Yukiko asked.

The knowledge that something,

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anything might lurk behind those walls restored them to a measure of coolness.

Save for livestock, the steading was deserted.

Rather than offend the dwellers by blasting down their barred door, the searchers went through a window on grav units. They found just one or two rooms on each story. Evidently the people valued ample floor space and high ceilings above privacy. Connection up and down was by circular staircases whose short steps seemed at variance with this. Decoration was austere and nonrepresentational. Furniture consisted mainly of benches and tables. Nothing like a bed, or an *o-futon,* was found; did the indigenes sleep, if they did, sitting or standing? Quite possibly. Many species can lock the joints of their limbs at will.

Stored food bore out the idea of carnivorousness. Tools, weapons, utensils, fabrics were abundant, well made, neatly arranged. They confirmed an Iron Age technology, more or less equivalent to that of Earth's Classical civilization. Exceptions occurred; for example, a few books, seemingly printed from handset type. How eagerly those pages were ransacked! But the only illustrations were diagrams suitable to a geometry text in one case and a stonemason's manual in another. Did this culture taboo pictures of its members, or had the boat merely chanced on a home which possessed none?

The layout and contents of the house, and of the sheds when these were examined, gave scant clues. Nobody had expected better. Imagine yourself a nonhuman xenologist, visiting Earth before man went into space. What could you deduce from the residences and a few household items belonging to, say, a European, an Eskimo, a Congo pygmy, and a Japanese? You might have wondered if the owners were of the same genus.

In time you could learn more. Turekian doubted that time would be given. He put Webner in a cold fury by his nagging to finish the survey and get back to the boat. At length the chief gave in. "Not that I don't plan a detailed study, mind you," he said. Scornfully: "However, I suppose we can hold a conference, and I'll try to calm your fears."

After you had been out, the air in the craft smelled dead and the view in the screens looked dull. Turekian took a pipe from his pocket. "No," Webner told him.

"What?" The pilot was bemused.

"I won't have that foul thing in this crowded cabin."

"I don't mind," Yukiko said.

"I do," Webner replied, "and while we're down, I'm your captain."

Turekian reddened and obeyed. Discipline in space is steel hard, a matter of survival. A good commander gives it a soft sheath. Yukiko's eyes reproached Webner; her fingers lay on the pilot's arm. The

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xenologist saw. His mouth twitched sideways before he pinched it together.

"We're in trouble," Turekian said. "The sooner we haul mass out of here, the happier our insurance companies will be."

"Nonsense," Webner snapped. "If anything, our problem is that we've terrified the dwellers. They may take days to send even a scout."

"They've already sent two. You had to shoot at them."

"I shot at a dangerous animal. Didn't you see those talons, those fangs? And a buffet from a wing that big—ignoring the claws on it—could break your neck."

Webner's gaze sought Yukiko's. He mainly addressed her: "Granted, they must be domesticated. I suspect they're used in the hunt, flown at game, like hawks, though working in packs, like hounds. Conceivably the pair we encountered were, ah, sicced on us from afar. But that they themselves are sophonts—out of the question."

Her murmur was uneven. "How can you be sure?"

Webner leaned back, bridged his fingers, and grew calmer while he lectured: "You realize the basic principle. All organisms make biological sense in their particular environments, or they become extinct. Reasoners are no exception—and are, furthermore, descended from nonreasoners which adapted to environments that had never been artificially modified.

"On nonterrestroid worlds, they can be quite outré by our standards, since they developed under unearthly conditions. On an essentially terrestroid planet, evolution basically parallels our own because it must. True, you get considerable variation. Like, say, hexapodal vertebrates liberating the forelimbs to grow hands and becoming centauroids, as on Woden. That's because the ancestral chordates were hexapods. On this world, you can see for yourself the higher animals are fourlimbed.

"A brain without some equivalent of hands is useless in the wild. Nature would never produce it. The inhabitants are bound to be bipeds, however different from us in detail. A foot which must double as a hand, and vice versa, would be too grossly inefficient in either function. Natural selection would weed out any mutants of that tendency, fast.

"What could yonder ornithoids use for hands?"

"The claws on their wings?" Yukiko asked shyly.

" 'Fraid not," Turekian said. "I got a fair look. They can grasp, sort of, but aren't built for manipulation."

"You saw how the fledgling uses them to cling to the parent," Webner stated. "Perhaps it climbs trees also. Earth has a bird with similar structures, the hoactzin. It loses them in adulthood. Here they may well become extra weapons."

"The feet," Turekian scowled. "Two opposable digits flanking three

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straight ones. Could serve as hands."

"Then how does the creature get about on the ground?" Webner retorted. "Can't forge a tool in midair, you know, let alone dig ore and erect stone houses."

He wagged a finger. "Another, more fundamental point," he went on. "Fliers are too limited in mass. True, the gravity's weaker than on Earth, but air pressure's lower. Thus admissible wing loadings are about the same. The biggest birds which ever lumbered into Terrestrial skies weighed some fifteen kilos. Nothing larger could get aloft. Metabolism simply can't supply the power required. We've established that local biochemistry is close kin to our type. Hence it is not possible for those ornithoids to outweigh a maximal vulture. They're big, yes, and formidable. Nevertheless, that size has to be mostly feathers, hollow bones—spidery, kitelike skeletons anchoring thin flesh.

"Aram, you hefted several items around this place, such as a stone pot. Or consider one of the buckets, presumably used to bring water up from the river. What would you say the greatest weight is?"

Turekian scratched in his beard. "Maybe twenty kilos," he answered reluctantly.

"There! No flier could lift that. It was always superstition about eagles stealing lambs, or babies. They weren't able to. The ornithoids are similarly handicapped. Who'd make utensils he can't carry?"

"M-m-m," Turekian growled rather than hummed. Webner pressed the attack:

"The mass of any flier on a terrestroid planet is insufficient to include a big enough brain for true intelligence. The purely animal functions require virtually all those cells. Birds have at least lightened their burden, permitting a little more brain, by changing jaws to beaks. So have those ornithoids you called 'watch-falcons.' The big fellows have not."

He hesitated. "In fact," he said slowly, "I doubt if they can even be considered bright animals. They're likely stupid . . . and vicious. If we're set on again, we need have no compunctions about destroying them."

"Couldn't he, she, it simply have been coming down for a quick, close look at you—unarmed as a peace gesture?" Yukiko whispered.

"If intelligent, yes," Webner said. "If not, as I've proven, positively no. I saved us some nasty wounds. Perhaps I saved a life."

"The dwellers might object if we shoot at their property," Turekian said.

"They need only call off their, ah, dogs. In fact, the attack on us may not have been commanded, may simply have been brute reaction after panic broke the order of the pack." Webner rose. "Are you satisfied? We'll make thorough studies till nightfall, then leave gifts, withdraw, hope for a better reception when we see the indigenes have re-

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turned." A television pickup was customary among such gifts.

Turekian shook his head. "Your logic's all right, I suppose. But it don't smell right somehow."

Webner started for the air lock.

"Me, too?" Yukiko requested. "Please?"

"No," Turekian said. "I'd hate for you to be harmed."

"We're in no danger," she argued. "Our side arms can handle any fliers that may arrive feeling mean. If we plant sensors around, no walking native can come within bowshot before we know. I feel caged."

The xenologist thawed. "Why not?" he said. "I can use a level-headed assistant." To Turekian: "Man the boat guns yourself if you wish."

"Like blazes," the pilot grumbled, and followed them.

He had to admit the xenologist knew his business. The former cursory search became a shrewd, efficient examination of object after object, measuring, photographing, commenting continuously into a minirecorder. Yukiko helped. On Survey, everybody must have some knowledge of everybody else's specialty. But Webner needed just one extra person.

"What can I do?" Turekian asked.

"Move an occasional heavy load," the other man said. "Keep watch on the forest. Keep out of the way."

Yukiko was too fascinated by the work to chide him. Turekian rumbled in his throat, stuffed his pipe, and slouched around the grounds alone, blowing furious clouds.

At the corral he gripped a rail and glowered. "You want feeding," he decided, went into a barn—unlike the house, its door was not secured—and found a haymow and pitchforks which reminded him of a backwoods colony on Hermes that he'd visited once, temporarily primitive because shipping space was needed for items more urgent than modern agromachines. The farmer had had a daughter—He consoled himself with memories while he took out a mess of cinnamon-scented red herbage.

"You!"

Webner leaned from an upstairs window. "What're you about?" he called.

"Those critters are hungry," Turekian replied. "Listen to 'em."

"How do you know what their requirements are? Or the owners'? We're not here to play God, for your information. We're here to learn and, maybe, help. Take that stuff back where you got it."

Turekian swallowed rage—that Yukiko should have heard his humiliation—and complied. Webner was his captain till he regained the blessed sky.

Sky . . . birds . . . He observed the "cotes." The pseudo-hawks fluttered about, indignant but too small to tackle him. Were the giant ornithoids kept partly as protection against large ground predators? Turekian studied the flock. Its members

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dozed, waddled, scratched the dirt, fat and placid, obviously long bred to tameness. One threshed the air toward a nest, clumsy as a chicken. Both types lacked the gill-like slits he had noticed . . .

A shadow. Turekian glanced aloft, snatched for his magnifier. Half a dozen giants were back. The noon sun flamed on their feathers. They were too high for him to see details.

He flipped the controls on his grav unit and made for the house. Webner and Yukiko were on the fifth floor. Turekian arced through a window. He had no eye, now, for the Spartan grace of the room. "They've arrived," he panted. "We better get in the boat quick."

Webner stepped onto the balcony. "No need," he said. "I hardly think they'll attack. If they do, we're safer here than crossing the open."

"Might be smart to close the shutters," the girl said.

"And the door to this chamber," Webner agreed. "That'll stop them. They'll soon lose patience and wander off—if they attempt anything. Or if they do besiege us, we can shoot our way through them, or at worst relay a call for help via the boat, once *Olga*'s again over our horizon."

He had re-entered. Turekian took his place on the balcony and squinted upward. More winged shapes had joined the first several; and more arrived each second. They dipped, soared, circled through the wind, which made surf noises in the forest.

Unease crawled along the pilot's spine. "I don't like this half a bit," he said. "They don't act like plain beasts."

"Conceivably the dwellers plan to use them in an assault," Webner said. "If so, we may have to teach the dwellers about the cost of unreasoning hostility." His tone was less cool than the words, and sweat beaded his countenance.

Sparks in the magnifier field hurt Turekian's eyes. "I swear they're carrying metal," he said. "Listen, if they are intelligent—and out to get us after you nearly killed one of 'em—the house is no place for us. Let's scramble. We may not have many more minutes."

"Yes, I believe we'd better, Vaughn," Yukiko urged. "We can't risk . . . being forced to burn down conscious beings . . . on their own land."

Maybe his irritation with the pilot spoke for Webner: "How often must I explain there is no such risk, yet? Instead, here's a chance to learn. What happens next could give us invaluable clues to understanding the whole ethos. We stay." To Turekian: "Forget about that alleged metal. Could be protective collars, I suppose. But take the supercharger off your imagination."

The other man stood dead still.

"Aram." Yukiko seized his arm. "What's wrong?"

He shook himself. "Supercharger," he mumbled. "By God, yes."

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Abruptly, in a bellow: "We're leaving! This second! They *are* the dwellers, and they've gathered the whole countryside against us!"

"Hold your tongue," Webner said, "or I'll charge insubordination."

Laughter rattled in Turekian's breast. "Uh-uh. Mutiny."

He crouched and lunged. His fist rocketed before him. Yukiko's cry joined the thick smack as knuckles hit—not the chin, which is too hazardous—the solar plexus. Air whoofed from Webner. His eyes glazed. He folded over, partly conscious but unable to stand. Turekian gathered him in his arms. "To the boat!" the pilot shouted. "Hurry, girl!"

His grav unit wouldn't carry two, simply gentled his fall when he leaped from the balcony. He dared not stop to adjust the controls on Webner's. Carrying his chief, he pounded across the flagstones. Yukiko came above. "Go ahead!" Turekian bawled. "Get into shelter."

"Not till you can. I'll cover you."

The scores above had formed themselves into a vast revolving wheel. It tilted. The first fliers peeled off and roared downward. The rest came after.

Arrows whistled ahead of them. A trumpet sounded. Turekian dodged, zigzag over the meadow. Yukiko's gun clapped. She shot to miss, but belike the flashes put those archers—and, now, spearthrowers—off their aim. Shafts sang wickedly around.

Yukiko darted to open the boat's air lock. While she did, Turekian dropped Webner and straddled him, blaster drawn. The leading flier hurtled close. Talons of the right foot, which was not a foot at all but a hand, gripped a scimitar. For an instant, Turekian looked into the golden eyes, knew a brave male defending his home, fired to miss.

In a brawl of air, the native sheered off. The valve swung wide. Yukiko flitted through. Turekian dragged Webner, then stood in the lock chamber till the entry was shut.

Missiles clanged on the hull. None would pierce. Turekian let himself join Webner for a moment of shuddering before he went to Yukiko and the raising of his vessel.

When you know what to expect, a little, you can lay plans. We next sought the folk of Ythri, as the planet is called by its most advanced culture, a thousand kilometers from the triumph which surely prevailed in those mountains. Approached with patience, caution, and symbolisms appropriate to their psyches, they welcomed us rapturously. Before we left, they'd thought of sufficient inducements to trade that I'm sure they'll have spacecraft of their own in a few generations.

Still, they are as fundamentally territorial as man is fundamentally sexual, and we'd better bear that in mind.

The reason lies in their evolution. It does for every drive in every animal everywhere. The Ythrian is car-

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nivorous, aside from various sweet fruits. Carnivores require larger regions per individual than herbivores or omnivores do, in spite of the fact that meat has more calories per kilo than most vegetable matter. Consider how each antelope needs a certain amount of space, and how many antelopes are needed to maintain a pride of lions. Xenologists have written thousands of papers on the correlations between diet and genotypical personality in sophonts.

I have my doubts about the value of those papers. At least, they missed the possibility of a race like the Ythrians, whose extreme territoriality and individualism—with the consequences to governments, mores, arts, faiths, and souls—come from the extreme appetite of the body.

They mass as high as thirty kilos; yet they can lift their own weight in the air or, unhampered, fly like demons. Hence they maintain civilization without the need to crowd together in cities. Their townspeople are mostly wing-clipped criminals and slaves. Today their wiser heads hope robots will end that need.

Hands? The original talons, modified for manipulating. Feet? Those claws on the wings, a juvenile feature which persisted and developed, just as man's large head and sparse hair derive from the juvenile or fetal ape. The forepart of the wing skeleton consists of humerus, radius, and ulnar, much as in true birds. These lock together in flight. Aground, when the wing is folded downward, they produce a "knee" joint. Bones grow from their base to make the claw-foot. Three fused digits, immensely lengthened, sweep backward to be the alatan which braces the rest of that tremendous wing and can, when desired, give additional support on the surface. To rise, the Ythrians usually do a handstand during the initial upstroke. It takes less than a second.

Oh, yes, they are slow and awkward afoot. They manage. Big and beweaponed, instantly ready to go aloft, they need fear no beast of prey.

You ask where the power comes from to swing this hugeness through the sky. The oxidation of food, what else? Hence the demand of each household for a great hunting or ranching demesne. The limiting factor is the oxygen supply. Turekian first understood how that is increased. The Ythrian has lungs, a passive system resembling ours. He also has his supercharger, evolved from the gills of an amphibian-like ancestor. Worked in bellows fashion by the flight muscles, leading directly to the bloodstream, those air-intake organs let him burn his fuel as fast as necessary.

I wonder how it feels to be so alive.

I remember how Yukiko Sachansky stood in the curve of Aram Turekian's arm, under a dawn heaven, and watched the farewell dance the Ythrians gave for us, and cried through tears: "To fly like that! To fly like that!" ■

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misinformation

The peculiar characteristic of creativity is that a man, given false clues, two misconceptions and eighty percent erroneous data comes up with a brand-new right answer!

HOWARD L. MYERS

Rof Tosen entered the outer office of the Bureau of Strategic Information and gazed about with dismay.

There were half a dozen Bureau staffers in the room, and his emo-monitor picked up high enthusiasm from each of them. But it was obvious at a glance that the enthusiasm was not for their work.

Three were huddled in conversation that seemed to concern, from the snatches Tosen overheard, the doings of their various children. Two others were seated at their desks using their communicators. One of these, a man, was close enough for Tosen to gather that he was discussing plans for a hunting trip on the planet Glarsek.

Only one was going through the motions of handling some paperwork, and her main attention was fo-

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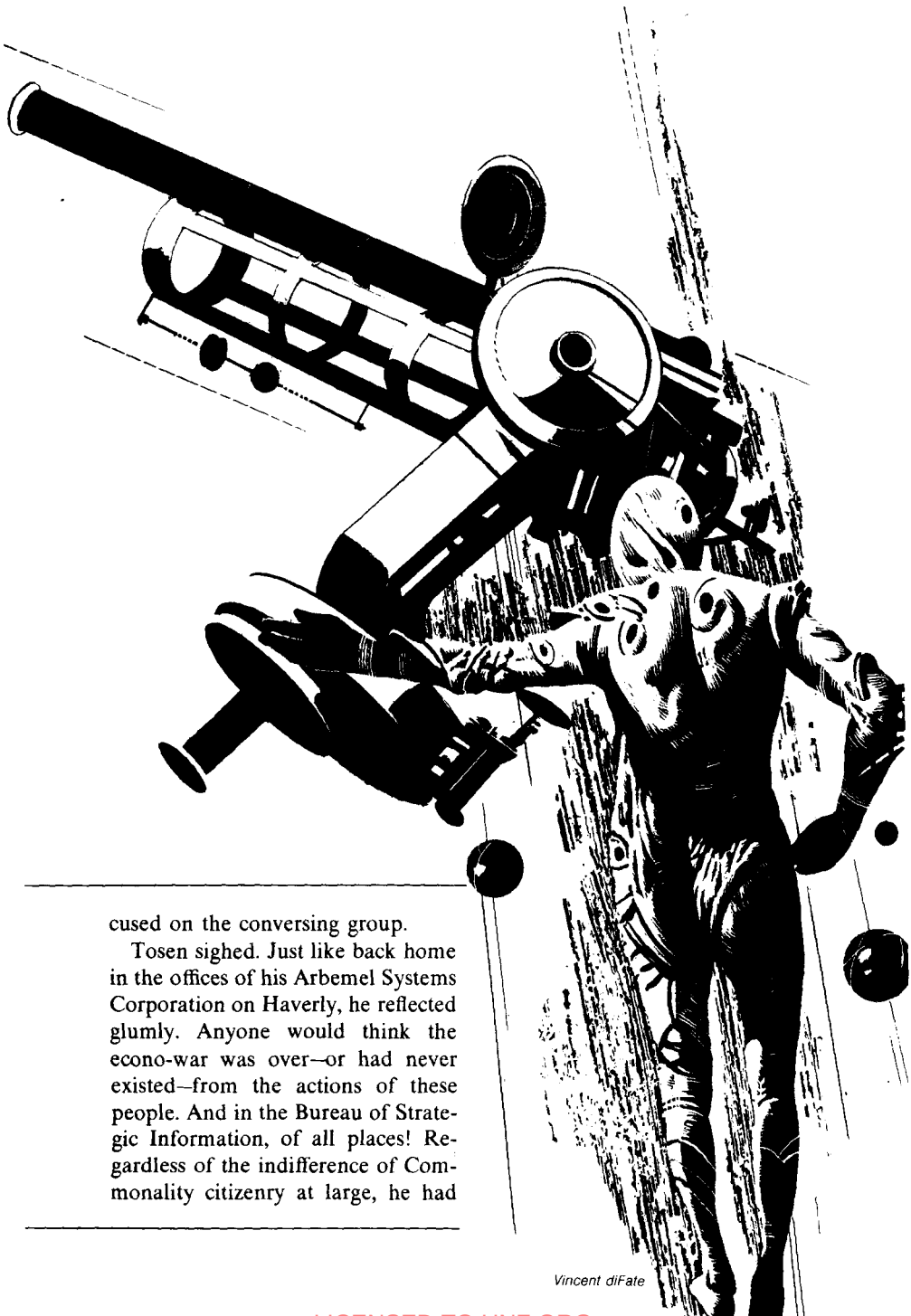

Vincent diFate

cused on the conversing group.

Tosen sighed. Just like back home in the offices of his Arbemel Systems Corporation on Haverly, he reflected glumly. Anyone would think the econo-war was over—or had never existed—from the actions of these people. And in the Bureau of Strategic Information, of all places! Regardless of the indifference of Commonality citizenry at large, he had

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expected somehow to find competitive morale still running strong here.

The woman doing paperwork looked at him. "May I help you?" she asked.

"I'm Rof Tosen," he said. "I have an appointment with Stol Jonmun."

"The Bureau chief won't be in this week," she replied. "Dave Mergly will see you instead. This way, please."

She rose, ignoring the flash of annoyance from Tosen, and led the way up a jumpshaft and along a corridor. Dave Mergly was the one man in the Bureau Tosen had hoped to avoid. He was Stol Jonmun's top assistant in charge of saying "no". But if Jonmun was out gold-bricking like everyone else . . . well, it would have to be Mergly.

The woman guided him into Mergly's office and departed. The two men studied each other for a moment. Dave Mergly was middle-aged, several years Tosen's senior, and was one of those men who remained slender with minimal exercise. He could burn up energy simply sitting at a desk. A high-tension type, Tosen reflected—and clearly that way as a matter of genetics, because psych-releasers made doubly sure, when treating government officials, that every possible source of uncanity was fully lifted.

Tosen's emo-monitor read the bureaucrat's attitude as one of detached curiosity, which gradually shifted into reserved approval, as they studied each other.

Mergly's thin lips bent in a slight smile. "Still competing, Tosen?" he asked.

"Trying to. You, too, I would judge."

"Yes. Not many of us around anymore. Welcome into the shrinking minority. Have a seat."

Tosen lowered into a chair, asking, "You holding the fort alone, here in the Bureau?"

"Not quite. How about your company . . . Arbemel Systems, isn't it?"

Tosen nodded. "I've got two good men. Mike Stebetz in Management and Clarn Rogers in Research. Makes two out of a payroll of sixty-seven hundred."

"Three counting yourself," observed Mergly. "A little better than average, I would say." He studied Tosen for a moment, then asked, "How do you explain the situation, Rof?"

With a shrug Tosen replied, "I don't have any original thoughts on the subject. The obvious answer is that the public at large considers the econo-war to be over, so they're no longer participating in it. The Lontastan Federation, with its telepath Monte, has an overpowering advantage over us. So the average citizen considers it all over but the official surrender and seizure."

Mergly frowned. "The Commonality has been in tight squeezes before, and managed to squirm out, and morale didn't go to pot while we

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were doing it. Remember old Radge Morimet?"

"No, he predated me by ten years. But, of course, I'm familiar with what he accomplished—and what he didn't accomplish. His motto was 'war in our time,' and let the next generation worry about war in its time. Well, we're the next generation, and the compromises he made to keep the econo-war going have made our position even more difficult. He managed to squirm, but in doing so he left no squirming room for us.

"I think the public realizes that," Tosen continued thoughtfully. "The time is past when we can find a short-term answer by compromising the philosophical foundation of the econo-war. Morimet didn't leave us any compromises to make. Except for a handful of diehards, which includes the two of us, nobody sees any possibility of bringing the war back to life."

"And the public doesn't seem to care," grunted Mergly.

"Oh, the people care, all right," Tosen disagreed. "I have talked to a lot of the people in my company about it. They regret the ending of the war, but without panic or grief. That's the sane way to face a loss, no matter how tremendous it is. We're inclined to misjudge their reaction—and this is something to think about—because this is the first major social crisis humanity has faced since we attained racial sanity, nearly a thousand years ago. We listen for screams of anguish and look for people wringing their hands, or lashing out angrily at everybody and everything, or sinking into the apathy of defeat. But such responses from the Earth-Only days are no longer in character."

Mergly nodded slowly. "A good point. The people write off their loss and fall back on what they have left—their purely personal interests, their love for their families, and what not. Meanwhile, our social structure collapses about us."

"Yes," Tosen agreed. "That's what the econo-war was for, essentially . . . to stimulate the individual's motivation as a functioning member of a racial social structure."

"Then why," demanded Mergly, "are we few diehards still hanging on?"

"Maybe because we're more informed than most on how damaging a social collapse could be. At the best, we would have a stasis civilization. At worst, we could slide back into unsanity. Unless . . . and this is a trillion-to-one shot . . . some sublime genius of a philosopher discovered some presently unsuspected Higher Purpose for humanity to pursue."

Mergly gave a dry chuckle. "Another explanation for us diehard types," he said, "could be that we still see, or imagine, some thin hope to cling to."

"Yes," nodded Tosen, "there's that."

"Which gets us around to the real

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reason for your visit, doesn't it?"

Tosen hesitated. "I'd rather not have my scheme termed a 'thin hope' before you've even heard it," he said with a grin.

Mergly nodded, and his emo reading was a cold nothing. He was, Tosen guessed, all set to listen analytically—and thoroughly critically—to the proposal. "Go ahead," he said.

"What I have in mind," Tosen began, "would get us away from damaging compromises, and hit at the basic imbalance in the econo-war. That is, at the fact that the Lontastan Federation has Monte, and the Commonality of Primgran doesn't. Essentially, Monte was the first compromise. The Lontastans should never have allowed a nonhuman to participate in what was a purely human conflict. Do you agree with that?"

"Yes."

"Unless, of course, Monte isn't a nonhuman life form at all," Tosen added, eying the Information man closely.

Mergly blinked. "Oh? You think there's room for doubt about that?"

"That's what I'm here to find out. Let's consider what we think we know about Monte, and why we think we know it.

"First, he's a huge globe in form, perhaps a hundred meters in diameter, with a stonelike shell of sufficient thickness and strength to support that tremendous weight on a planet of approximately Earth-gravity. Second, he's a one-member species that does not produce offspring, and presumably had his genesis in the earliest stages of the life-formation processes on his planet, perhaps a billion years ago. Third, a Lontastan exploration team entered his star's planetary system and discovered him, and he volunteered his services in the econo-war very soon thereafter.

"Now, we aren't dealing with impossibilities in any of those three areas—that is, Monte's present form, his history, or his discovery by man. But I suggest each of the three holds substantial improbabilities, and when all of them are combined the likelihood of truth is statistically slight.

"For example, such giant size and mass would create problems of inadequate muscular strength for mobility, of finding sufficient nourishment, and of dissipating body heat. A Monte creature ought to be immobile, and stewing in its own weak juices.

"And yet, this creature reportedly has survived and grown through most of the geologic ages of his planet. Earthquakes, floodings, volcanic eruptions, ice incrustations . . . he got through them all.

"And then this creature, after a billion years of total intellectual solitude, becomes a 'joiner' as soon as he encounters humanity!"

Tosen paused, then added, "I don't say all this is impossible. Merely improbable."

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Frowning, Mergly countered, "Perhaps; perhaps not. Every difficulty you cite can be explained. The matter of nourishment, for instance, seems to be handled in large part by a process similar to photosynthesis, called radiosynthesis. Radioactive ores would have been plentiful and rich in Monte's youth—and incidentally there may have been many small Montes back then, making the survival of one far more probable. The nourishment problem would have built up with the passage of time, I agree. And according to some reports I've seen, that could explain Monte's eagerness for human associates. People can mine and refine radioactives for him to bed down in.

"I won't bother to cover all your 'improbables'," Mergly concluded with a shrug. "Presumably you've studied the matter sufficiently to know the explanations yourself. My question is why do you even bother to bring the subject up?"

"Because despite the explanations, the improbables are still just that," retorted Tosen. "And if there is any reason to believe the account of Monte we have is based on misinformation, we might be well-advised to assume a more believable account of what he is, and how he got that way."

Mergly's eyebrows raised and he flickered annoyance. "Misinformation?" he said.

"That's what I want you to tell me," said Tosen quickly. "What are the sources of our data concerning Monte? How close has one of our own agents ever got to him? Have we ever captured and questioned a Lontastan who had *direct* knowledge of Monte's physical nature?"

There was a moment of silence. "You're suggesting the Lontastans have sold us a comet tail," Mergly said slowly.

"Could be. I want to know if any of our data on Monte is unimpeachable enough to prove me wrong."

"Well . . . as you know, Lontastan security around Orrbaune is extremely tight," said Mergly. "As soon as one of our agents breaks warp anywhere in the planetary system he's detected telepathically. And he can't stay long . . . everybody's jumpy about intruders these days, partly because of the crisis condition of the econo-war, and partly because Radge Morimet brought unsane motivation into play. The Lontastan Guardsmen blast away at an agent immediately, on the chance that he might be some kind of nut with a superweapon in his pocket.

"As for picking up direct data on Monte from a captured Lontastan, I'd have to check on that, but I believe all information from such sources is third-hand at best. For the moment, I'll go along with your notion that the Monte story has been falsified. The question remains, what good would this falsification do the Lontastans? And what can we gain by penetrating it?"

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"Easy," smiled Tosen. "If Monte's not a living being, the most probable alternative is that he's a machine built by the Lontastans. If we are led to *think* the Monte machine is a being, we won't try to build one of our own. After all, anything the Lontastans can build, so can we. But a telepathic life form isn't one of those things . . . biotechnics just isn't up to it. Thus, the Lontastans develop a telepathic device, make us believe it's a natural life form, and keep a monopoly on their gadget."

"But why on such an out-of-the-way planet as Orrbaune?" protested Mergly. "Would they actually go to the trouble of shifting their capital way out there, if Monte were indeed a machine that could be built presumably anywhere?"

"Sure, for verisimilitude!" exclaimed Tosen. "And for security reasons, too. Keep in mind that, back before they had Monte, we had the upper hand in the war. They hadn't broken our monopoly on implanted emo-monitors then, and our undercover agents and saboteurs were having a field day on their central worlds. When they hit on the telepathy gimmick, they had to spirit their development team off somewhere, to such an undeveloped world as Orrbaune, to keep the project secret from us.

"But if they had started building Monte machines on all their major planets, we would have caught on quickly. So they built just the one . . . and on a planet where a startling life form might *possibly* have been discovered, and started spreading their tall story."

Mergly nodded slowly, and Tosen felt a calm elation.

"Of course," Mergly said, not quite willing to be convinced, "what you have here is a purely suppositional structure."

"Yes, but one that, if I'm right, could straighten out the entire econo-war mess and get everybody back in competition. But I agree it would help if we had more dependable data to go on."

"Such as what?"

"Such as an agent might get during a very close—though necessarily quite brief—approach to Orrbaune. For a moment our man would be in the thick of the telepathic communications network that Monte provides the personnel on the planet, not merely within range of telepathic detection. He might get a surprise reaction from Monte, especially if it is a living creature. And he might pick up thoughts from the local humans who have first-hand knowledge of the telepath."

Mergly was radiating impatience. "Who's dealing with extreme improbabilities now?" he snorted. "But never mind that for a moment, since I can see from your emo that you think you know how such a close approach could be made. If you're asking me to assign a Bureau agent to that mission, the answer is NO. For the very good reason that we no

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longer have an agent fit for that type of job."

"No agent?" murmured Tosen.

"They've all turned noncompetitive," grunted Mergly. "Which makes sense from their viewpoint. Agents are among the few people who actually risk their lives in the conduct of the econo-war. That takes strong motivation, which present conditions don't provide."

"But if it was explained to one that this mission might revitalize the econo-war . . ." Tosen began.

"He would laugh at you," Mergly responded. "Have you tried to explain your scheme to a noncompetitor?"

"Well, yes. To my wife."

"What did she think of it?"

"She laughed," Tosen admitted lamely.

Mergly's smile was sour. "So there you are. You have a suppositional structure, which you need more data to substantiate sufficiently to impress someone who has turned noncompetitive. But to get that data, you have to impress a noncompetitive agent with your suppositions. Quite a dilemma."

After a silence, Tosen said, "There's one answer to it: I can make the jaunt to Orrbaune myself if you'll agree."

"That's a deadly game for an amateur," replied Mergly.

"I know," said Tosen.

Four light-days away from Orrbaune's sun Tosen came out of warp, well outside telepathic detection range.

For an instant he felt a purely subjective chill, so distant from a sun's warmth and clad only in the shorts, sleeveless shirt and low boots normally worn by space travelers. However, the tiny implanted devices of his life-support system were keeping him warm while they protected him from the vacuum, and from the high-energy particles of interstellar space. And embedded in the tissues of his throat and nasal passages were gas-converting macromolecules to permit normal breathing.

He torqued his repulsor field to start himself spinning slowly, blinked tightly to turn on his amplisight, and peered about for the equipment pod which had been set to follow three seconds behind him through warp. This was an uncertainty-filled point in his mission—finding his equipment—because warping over a two-hundred-light-year jump was not totally precise. His pod might emerge on top of him or fifty thousand miles away. And it could not make any blatant announcement of its location so near the Lontastan capital system . . . it had a powerful red blinker for Tosen to look for, and that was all.

Without the equipment in the pod, he might as well warp for home immediately. He had to have it, and it could not have made the trip through warp with him. A man-sized mass was about the maximum that could move at warp velocities with-

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out stirring up mind-wrecking turbulence in prime-field.

So Tosen spun slowly in space, straining for a glimpse of the red blinker.

He almost missed it. It was a dim flicker in his peripheral vision that vanished when he tried to look directly at it. But he had its direction spotted. He activated his propulsor field and zoomed toward it on semi-inert mode.

Within fifty yards of the pod he went full-inert and drifted in slowly. The pod was a slender torpedo of dull red, and the color went black when he reached and killed the blinker. After activating the automatic setup system, he drifted a few feet away while he watched the pod unfold, extend a framework of slender lattices, and fan out a thin pie-slice of silver into a six-meter telescope mirror. When the components clamped together and motion stopped, he drifted to the eyepiece and swung the instrument to point in the direction of Orrbaune.

Basically it was an ancient device that would have been readily recognized for what it was back in Earth-only times—an astronomical reflector telescope. It was rendered more effective by an ampli-sight attachment and tight-line tracking, but its mirror optics differed little from those used by men to peer into space even before man himself could leave old Earth's atmosphere.

Tosen grinned at the sheer size of the instrument. Who would imagine a spy using such a big, cumbersome gadget?

And that was the whole point. Nobody had imagined it, and that was why it had never been tried. People were used to thinking of space equipment in pill-sized packages . . . devices small enough to place in the various available nooks and crannies of the human body without making noticeable bulges. Like ampli-sight, for example, for which a specialized field phenomenon was produced by specklike transmitters located within the eyeballs.

Being sane, Tosen mused as he busied himself with the telescope, only gave individuals access to such abilities as they inherently possessed. It was no guarantee of great wisdom, or of creative imagination. He felt himself fortunate to possess the latter of these.

He spent fifteen hours working with the telescope and its computer attachment, getting the data he needed. When his series of observations was complete, he knew his position and motion relative to Orrbaune with more exactitude than any earlier Commonality agent. He figured on a maximum margin of error of ten miles.

Satisfied at last, he activated the breakdown system and watched the telescope collapse back into the compact pod configuration. When the process was complete, he switched on the systems of the pod's record-and-home automatic sequence.

Then he drifted away from the

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pod, carefully set up his approach vector, and warped toward Orrbaune.

He exited into norm space almost sitting on the planet. His altitude was only two hundred miles, and his inert momentum in relation to the surface was near zero.

But he had no time to congratulate himself on this success. He was too busy observing with every implant-augmented sense he could bring to bear. He had a lot to try to learn in the two seconds he had allowed himself.

At that, he nearly overstayed. The Lontastans were skittish indeed about unheralded visitors—and especially one appearing almost on top of their heads. Tosen realized as he automatically went into warp and zipped away that he had felt the first few milliseconds of a zerburst flare that had blossomed within a few hundred meters of where he had been. He could feel the burn all across his back, and could detect his medicircuits going to work on the damage.

What had he learned?

He wasn't sure, but he hadn't expected to be at this stage. The important information, he hoped, was that which had been gathered by his special sensing devices and transmitted to the pod, to be recorded and transported home.

But at any rate, his memory of those two seconds held nothing to indicate Monte was not a device.

There *had* been telepathic contact. It had come so swiftly after his exit from warp that he had noticed no time lag.

But the . . . the *feel* of that contact was, at first, impersonal, without even mild emotion. Would a living telepath have such a feel? Tosen had never experienced telepathy before, but he doubted it.

Then, a split-second later, that impersonal feel was lost in a welter of obviously human thought-patterns as alerted Guardsmen came storming into the telepathic linkage with the expected reactions of alarm and anger, and harsh demands that the intruder identify himself instantly.

All in all, Tosen considered his mission to Orrbaune a complete success.

He left a confused flurry of exchanges behind him.

Who was that? demanded Frikason of the Lontastan High Board.

Monte replied: *His identity was not revealed, as his attention was so totally on receiving data that he transmitted very little. However, he was from the Commonality, and his purpose came through clearly.*

Oh? What was it?

To obtain information to verify his belief that I'm a machine, not a living being. Monte's thought was obviously amused. *If I were a machine, it would be possible for the Commanality to build my counterpart. That was his intention.*

Frikason along with several others

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present shared Monte's amusement.

Then from Frikason: *In a way it's too bad he's so completely off the track.*

True, agreed Monte. *The deterioration of the econo-war game is regrettable, and my equivalent on the Primgranese team would be the ideal way to restore the balance. But extensive studies by myself in collaboration with a number of your scientists has produced the unavoidable conclusion: a telepathic device, or machine, lies totally beyond all present skills and knowledge, and may, in fact, be an impossibility. Whereas certain of the reasoning capabilities of the mind can be duplicated by computing devices, telepathy lends itself to no such mechanical production. It is too purely a life-function for that.*

After a moment of relative telepathic silence, a thought came from Garsanne of the High Board: *Surely even the Primgranese should have figured that out. Why did this spy think otherwise? Did he have an unsane motivator?*

No, replied Monte. *My impression was that he bases his belief on a logical—if thoroughly wishful—interpretation of such data concerning myself as the Commonality has obtained.*

Wishful indeed, remarked Frikason. *By the way, did he warp out safely?*

Yes, barely. He escaped with the equivalent of a bad case of sunburn.

Sadder but wiser, huh?

No, not wiser, Monte informed them. *As you know, there is practically nothing of what may be called personality in any one of my billions of telepathic attention units. Each is simply a circuit. The spy would not be able to distinguish the attention unit that detached his presence and revealed him to the nearest Guardsmen as the product of a living mind. As for the Guardsmen with whom he was in mental contact, able though they are for their assignments they are genetic barbarians of meager intellectual curiosity. Their knowledge of me is only of the hearsay type the spy discountenances.*

So he's going home, still thinking you're a machine he can duplicate, observed Garsanne. *Look, Tedaboyd, you'd better dispatch a couple of agents to learn his identity and see what he comes up with, just in case.*

The Lontastan Intelligence chief's thought was annoyed: *What couple of agents? I told the High Board months ago that I haven't got a decent agent left! They've all become slack-outs! And I can't say I blame them. Why should they stick their necks out for a war that is already won?*

Yes, I'm afraid we non-slack-outs are a vanishingly small minority, agreed Frikason. *Never mind trying to track down that spy. He can't possibly succeed, as Monte's told us. Let's get back to the task at hand of devising the least disastrous means of bringing the econo-war to an official close.*

Monte observed: *The Commonality of Primgran, though defeated, still has one strength we lack.*

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Oh? What's that? Frikason asked.

One highly-motivated agent, still on the job.

Tosen soon found himself needing all his high motivation.

"Why," demanded Mergly, glowering across Tosen's desk, "didn't you tell me you didn't have even the backing of your own research man?"

Tosen glanced sideways at Clarn Rogers, who was emoting offended surprise, then replied, "Because I didn't know." He grinned wryly and added, "I didn't bother to check with him."

"Why not?"

"Because I suspected what his answer would be."

Mergly growled, "So you got me to go to bat for you before the Council to get you an R-and-D contract, with my neck way out—not that I give a damn about my neck, but wasting what competitive push we've got left is another matter!"

"I don't think it's a waste," Tosen returned. "I think Rogers is wrong."

"But, Rof," Rogers complained, "a telepathic machine just doesn't make sense. Every piece of substantial research on the subject indicates that telepathy is a function of the ego-field, or the spirit, or soul, or whatever you want to call it. Definitely, telepathy is *not* a function of the physiological nervous system. Or at any rate, not basically. A proper nervous system, such as that of the creature Monte, doubtless is essential machinery to facilitate an ego-field's telepathic abilities—otherwise all humans would have it. But you certainly can't produce telepathy with a mere machine!"

"Psionic devices have been around for several centuries," Tosen remarked softly.

"Certainly," Rogers said, showing impatience, "but they function as accessories of the users' nervous systems, as relatively simple additional nerve-ends, so to speak. Very useful as controls for our life-support implants and what not."

"But it's the ego-field that makes a psionic device work, isn't it?" said Tosen.

Rogers wriggled. "Well, of course. But as a *small* added part of the nervous system under the ego-field's control! What you're proposing wouldn't be small. It would be several orders of magnitude more complex than the human brain itself, according to my understanding of what Monte is. You couldn't merely focus your attention on such a thing and make it work. You don't have that much . . . that much *attention!* Certainly not that much to spare."

Mergly asked Rogers, "Then what would you expect to be the result of the project if we carried it out?"

Rogers shrugged. "We would have a very large, very expensive, and very inactive conglomerate of close-connected macromolecules."

"As large as Monte is reported to be?" demanded Mergly.

"No. We can crowd more functional capacity into artificially pro-

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duced macromolecules than you find in living tissue, and use more concentrated energy sources. The construct would be less massive than Monte's living brain, but approximately as complex. I would estimate the diameter at two meters."

Tosen smiled inwardly at Rogers's insistence on thinking of Monte as a living creature, despite the flat, mechanical emo-quality of the telepathic contact made with him on his spying jaunt—that quality having been duly recorded and scrupulously analyzed since his return.

Now he kept silent as Mergly and Rogers continued the discussion. He was for the moment in the bad graces of both men for getting them involved in a project they considered half-baked at best. But they were both good constructive competitors who would, if they could, find a way to salvage something useful from the mess his "irresponsibility" had created.

In the meantime, his research man and the government's Information man were a team from which he was excluded. So the less he had to say, the better.

"Assuming that Monte is a natural life form," Mergly said, "with a brain as massive as that assumption would suggest, wouldn't our artificial construct be superior to him, provided it worked at all?"

"Interconnections would be much shorter," Rogers nodded, "which would permit faster responses. But, of course, it wouldn't work at all. It would be a sumptuous mock-up of a superior central nervous system, capable of producing billions of responses of the quality Rof picked up from Monte. But it would be an *uninhabited* mock-up. It would be dead."

After a pause, Mergly said, "Yes, but would it stay that way?"

"What do you mean?"

Mergly shifted in his seat and frowned. "There's much we don't know about the disembodied ego-field, even though that's a state we've all gone through. The experience just doesn't carry over to the normal embodied state; perhaps there are too few similarities to use as guides. My own impressions of disembodiment are completely vague. I'm wondering . . . would our artificial construct be attractive to a disembodied ego-field? Could it be *made* attractive?"

Rogers blinked. "That's a possibility, I suppose. We don't know what attracts an ego-field into a newly-created life form, such as a human baby, although there's no shortage of conflicting theories. There are, certainly, the physical pleasures, such as sex. Perhaps a structure that facilitated telepathic communication would have its attractions."

"O.K., and if that didn't do the trick," Mergly persisted, "couldn't pleasure-producing circuits, or physical structures, be added on?"

"Well, yes, in an artificial way. But let me put it like this: Would you

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want to live in a body composed completely of prosthetics?"

Mergly frowned. "No."

"Well, that's what we would be offering any interested ego-field. Strictly ersatz, second-rate physical pleasures. I think telepathy would be the real—perhaps the only—attraction we could offer."

Mergly considered this in silence, displaying a varying emo-pattern as he did so. Then suddenly his pattern went clean and he rose from his seat. Obviously, he had decided.

"O.K., Clarn," he said to Rogers. "Get on with the project. Build that structure, and we'll see if anyone moves in. We're taking a shot in the dark, but," he shrugged, "these are rather frantic times." His eyes moved to Tosen and he added, "Frantic enough to justify frantic schemes I'm sure."

Tosen was radiating triumph, and the contrite tone of his "Thank you, Dave" fooled nobody.

He stayed on the side lines of Project Bauble as the research and development work moved ahead. He assisted Rogers mostly by seeking out people in the company who hadn't gone completely noncompetitive, giving them exciting sales pitches about "something big and revolutionary" going on in the lab, and sending on to Rogers the recruits who responded with genuine interest.

Within a month, there was a notable difference in atmosphere at Arbemel Systems Corporation. It wasn't back to the status of Hot Econo-war times, but had shifted in that direction. Even Tosen's secretaries were showing alert interest in their work, whereas before the project started their attention had been dispersed over such areas as the care and feeding of each other's children, beauty regimens, and in a few cases astrology. Now they were trying to outdo each other once more in demonstrating their efficiency.

Tosen was pleased. Whatever the outcome of the project, he had restored for a while, and within the limited confines of his company, the old spirit that had brought humanity so far and so fast.

But he knew the spirit would die quickly if the Bauble did not come alive.

Mergly was spending at least as much time on Haverly, at the Arbemel lab, as he was on the capital planet. Project Bauble was, after all, about the only real action going, so far as econo-war effort was concerned. Mergly wanted to keep an eye on it . . . and make sure there were no Lontastans doing the same.

"I've taken the liberty," he told Tosen after the project had been underway for several months, "of having the Arbemel floating stock purchased quietly for a Commonality trust."

Tosen nodded. "A good move," he said. "Since the bottom dropped out of the market three years ago, I've been uncomfortably aware of the

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possibility of being descended upon by a team of referees from Exchange World, with the news that Lontastans had bought a majority interest in the company for peanuts and had voted to liquidate."

"That wouldn't have been likely," said Mergly. "Why would they want this company, even for peanuts, the way things were? But now, because of the project, which they might find out about, we can't have a majority of the stock loosely held."

"How much did you buy for the trust?" Tosen asked.

"Forty-one percent."

"With my fourteen, that makes us safe." Tosen fiddled with the antique ballpoint pen he kept on his desk. "Been in the lab lately?" he asked.

"I just came from there."

"How are Rogers and his people doing?"

"They're coming along." Mergly paused, then added, "The Bauble will be complete next week, he says. This has been an expensive undertaking, Rof. The Council wouldn't have stood still for it if they had known what a gamble it is, or if other projects had been competing for R-and-D funds."

Tosen made a face. "O.K., you can consider me chastised. But despite all informed opinion to the contrary, I still believe the evidence favors Monte being an artificial, Lontastan-built structure, concerning which everyone but a few top Lontastans has been fed a load of misinformation."

"Maybe so," Mergly answered coolly. "We can hope so. If *they* haven't sold us misinformation, then *you* certainly have."

The Bauble had a pearllike luster, and Tosen decided as soon as he walked in the lab and saw it that it was well though deceptively named. A big bauble in appearance, but no bauble at all in price.

Rogers and Mergly were both there, gazing expressionlessly at the two-meter globe of glittery gray.

"That's it, huh?" Tosen said to announce his presence. "When are you going to turn it on?"

Rogers gave him a blank look. "It's turned on. It was built with its energy sources activated. It stays turned on."

"Well?"

Rogers said, "It's not doing anything. No life in it."

"O.K. So we wait for an interested ego-field to come along and discover it," said Tosen.

"We've already waited three hours," Mergly complained. "What's more, we've paraded every pregnant woman on the company payroll through here . . . two hundred and seven of them."

"What for?"

"Oh, one of the ego-field traditions that seems solider than most," shrugged Mergly. "Disembodied ego-fields are supposed to hang around pregnant women, waiting for the moment one of them can inhabit her child."

Tosen nodded. He had never

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thought highly of that idea. Ego-fields like a swarm of starving beggars, all of them after a tidbit only one could have! It carried the concept of competition to an unpleasantly ugly extreme.

"You may as well have a seat and a drink and be comfortable, if you're going to join the watch," said Rogers.

Tosen did so. The three of them sat with little conversation for over an hour.

At last Mergly said, "We ought to take this in shifts."

Rogers agreed. "This could keep up for days."

"I started last," said Tosen, "so I'll take the first shift if you like. Until midnight, say?"

"O.K."

The others left and Tosen got himself a fresh drink.

How long, he wondered, would it be reasonable to wait? With knowledge of ego-field characteristics so uncertain, a definite answer to the question was impossible. But his hunch was that, if an ego-field were ever going to inhabit the Bauble, it would have done so before now. From all accounts, ego-fields were numerous. And they moved around constantly. One should have discovered the Bauble before now. Probably one had—and had either considered it an undesirable habitation, or had not even regarded it as a *possible* habitation.

And unencumbered by a body and brain, an ego field could presumably act with the swiftness of thought. Perhaps a hundredth of a second was all the time required for an ego-field to recognize a body's desirability and move in.

In which case the Bauble should have been inhabited within less than a full second after its completion. But that had not happened, not even in the first minute—nor the first hour—nor the first six hours.

Tosen sighed. So far as orders of magnitude were concerned, he realized uncomfortably, six hours resembled a century more closely than it did a hundredth of a second. So, if the Bauble were ever going to be occupied, chances were that it would have been so by now.

Another uncomfortable thought struck him for the first time, seriously undermining all his reasoning on the nature of Monte.

The Lontastans had, over the centuries, been less noted for innovation than the Primgranese. Usually, the Lontastans were content to copy, or improve upon, basic advances first made in the Commonality.

Would the Lontastans have gone to the extreme expense of a Project Bauble without foreknowledge that it would work?

It would have been most uncharacteristic of them, for sure. And Mergly could never have got Council support for *this* Project, except by arguing that this was something the Lontastans had already shown was possible.

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Tosen chuckled, because in the final analysis none of that mattered in the least. The econo-war was lost, thanks to an obviously alive Monte on the Lontastan team. So what resources and effort had been spent on Project Bauble was merely decreasing the wealth that would be available for Lontastan claimancy, when the Lontastans got around to demanding settlement of the war.

So, as far as he was concerned, the project had been a good final try, even if a rather frantic and poorly thought-out one . . . at the enemy's eventual expense.

Tosen leaned back in his seat and relaxed, gazing at the Bauble.

A very handsome piece of workmanship, he mused, whether it did anything but look pretty or not. Actually it could be more accurately described as something grown rather than something built, being produced by chemical processes that had their genesis back in Earth-Only times when crystals were grown for solid-state electronic components. While the Bauble could theoretically be subdivided into millions of individual macromolecules, it was in fact one super-macromolecule, since the linkages between its theoretical units were themselves molecular in nature.

It would have been one hell of a gadget—if it had worked.

Why did the ego-fields turn up their ectoplasmic noses at it? he wondered with sudden irritation.

Maybe he could find out.

He put down his drink, let himself go limp, and left his body. This was something any psych-released adult could do easily enough, but was a rather useless trick except when the body was dying, at which time the ego-field usually went exterior to escape the death trauma.

Now Tosen drifted a few feet behind and above his head, still controlling his body from a distance and looking at the Bauble with normal sight and at the same time perceiving it with vague field senses. He drifted forward very slowly and entered the Bauble.

It was . . . like and unlike a body. Or more exactly, like and unlike a mind. It was difficult to pin down the flaw of the place as an abode. A poor analogy would be the interior of an empty house, with no furnishings, no fixtures, no doors. Just walls that were, strangely, both stark and indistinct at once.

He realized that he was exterior rather than fully disembodied, and that this might alter his view considerably from that of a totally detached ego-field. But his impression was strong that the Bauble was so totally lacking in *hominess* that no ego-field could possibly find it livable.

He pulled out of it and returned to his body. The mental exercise had, unaccountably, left him slightly exhausted and very hungry.

He walked over to an autospenser, dialed himself a tray of supper, and returned to his chair to eat. When he finished, he laid back and napped for a couple of hours.

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Mergly came in promptly at midnight. "Nothing yet?" he asked.

"No, and I'm afraid not ever," said Tosen. He quickly explained why the time they had already waited should have been more than adequate for the Bauble to take on life, and why the Lontastans would not have tried to develop an artificial telepath.

"As a final check," he wound up, "I exteriorized and entered the thing to get the feel of the place. I wouldn't care to live there."

Mergly nodded slowly. "What was your feeling inside the . . ." he began, then hesitated. "Never mind describing it. I'll take a look for myself."

He sat down and relaxed. Tosen waited quietly for close to ten minutes before Mergly stirred and looked up.

"Well, what did you think of it?" Tosen asked.

"A vast empty place with hard echoes. That's about as close as I can describe it," Mergly replied thoughtfully. "Even with you along for company the emptiness felt overwhelming."

"I didn't go along," objected Tosen. "I stayed right here in my own comfortable noggin."

Mergly frowned. "Oh? Perhaps you didn't, at that. What I sensed, I believe, was that you had been there before me. Maybe some of you rubbed off inside."

Tosen laughed. "Could be. I felt half exhausted when I came out."

"So do I." Mergly yawned, and stared at the Bauble from beneath drooping eyelids.

"I'm going home," said Tosen heading for the door. "Tell Rogers I'll contact him around midday to see if he thinks it worthwhile for me to stand another watch."

"O.K.," replied Mergly. "I'll sug-

THE ANALYTICAL LABORATORY

DECEMBER 1971

PLACE	TITLE	AUTHOR	POINTS
1.	A Spaceship for the King (Pt. 1)	*Jerry Pournelle*	1.95
2.	Just Peace	*William Rupp and Vernor Vinge*	2.45
3.	Ecology Now!	*Wade Curtis*	3.56
4.	Foundlings Father	*Jack Wodhams*	3.81
5.	The Incompetent	*Chris Butler*	3.95
6.	Priorities	*Ben Bova*	4.90

JANUARY 1972

1.	A Spaceship for the King (Pt.2)	*Jerry Pournelle*	2.16
2.	"Riddle Me This . . ."	*Christopher Anvil*	2.42
3.	A Matter of Sovereignty	*Wade Curtis*	2.81
4.	The Greatest Asset	*Isaac Asimov*	4.32
5.	Stormy Bellweather	*Jack Wodhams*	4.44
6.	Truck Driver	*Robert Chilson*	4.64

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gest that he take a feel inside the Bauble, too. He might have some ideas on how to make it more homey."

Walking down the hallway Tosen replied, "O.K., no harm in asking him. But I feel the Bauble's flaws are too basic to be remedied easily or cheaply." He paused outside the lab to gaze upward into the clear, starry night. Then he activated his transport implants and soared up and westward toward his home. "At the least," he added, "we would have to start again from scratch and build a completely different kind of Bauble. What would the Council say to that?"

Mergly emoted such a violent shudder that Tosen chuckled.

"I'm glad you can feel amused," complained Mergly with a flash of anger. "Unfortunately, I can't share that don't-give-a-damn attitude you've taken on. It smacks of noncompetitiveness to me."

Tosen flinched. "Sorry," he said. "I got us into this thing, and I'd have no business turning deserter now."

"I didn't say you were a deserter," Mergly denied.

"No, but you felt it . . . or thought it." Suddenly Tosen gasped and whirled his body, searching the upper atmosphere for sight of Mergly. *"Say, where the hell are you, anyway?"*

"Why . . . right here in the lab, in my body."

Tosen watched through Mergly's eyes as the Information man looked away from the Bauble to search the room for the man he had been talking to. "Where are *you?"* Mergly demanded, then added, "Oh . . . I . . . see."

The damned thing works! Tosen exulted.

But just for us? from Mergly, whose mind was tumbling confusedly.

Sure! The Bauble's not a living telepath like Monte. It's merely a gadget! It doesn't reach out. We have to reach in. Give it our individual punched cards, so to speak. And so far, only you and I have reached in! You felt I had been there before you, remember. That was because it had my pattern. It has yours, too. I'm going to flip on this antique toothmike of mine and call Rogers, while you warp for the capital to give the Council the news!

Very well, but . . . but this is difficult to take in, Rof. Not thirty minutes ago you had me convinced the Bauble couldn't possibly work, that the whole project was based solely on your wishful thinking and misinformation . . .

Tosen thought a big happy smile. *Dave, we'd all still be living in Earth caves if we hadn't wished for things we couldn't possibly have. And as for misinformation . . .*

Yes? Mergly prompted.

Well, when misinformation says the impossible can be done instead of the other way around, then it just might turn out to be the truest information you ever heard! ■

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skylab

Conclusion. The first three astronauts to fly the Skylab for 28 days have a tough job. But the real scientific work will be done by the two follow-up crews scheduled to live in space for a record 56 days each!

Joseph Green

Early in 1973 a Saturn 1B vehicle, designated Skylab 3, will lift off a modified Saturn V launch pad at the Kennedy Space Center, carrying into orbit three astronauts. One of them will probably be an astronomer by education and pre-astronaut training. After the two vehicle stages have burned out the Command Service Module (CSM) will fire its single engine and rendezvous with the largest object placed in Earth orbit to that date, the Saturn Workshop (SWS). When the CSM docks to the axial port of the SWS the complete Cluster is called Skylab, the first U.S. space station. This will be the beginning of the second stay in Skylab by three men, and assuming no physi-

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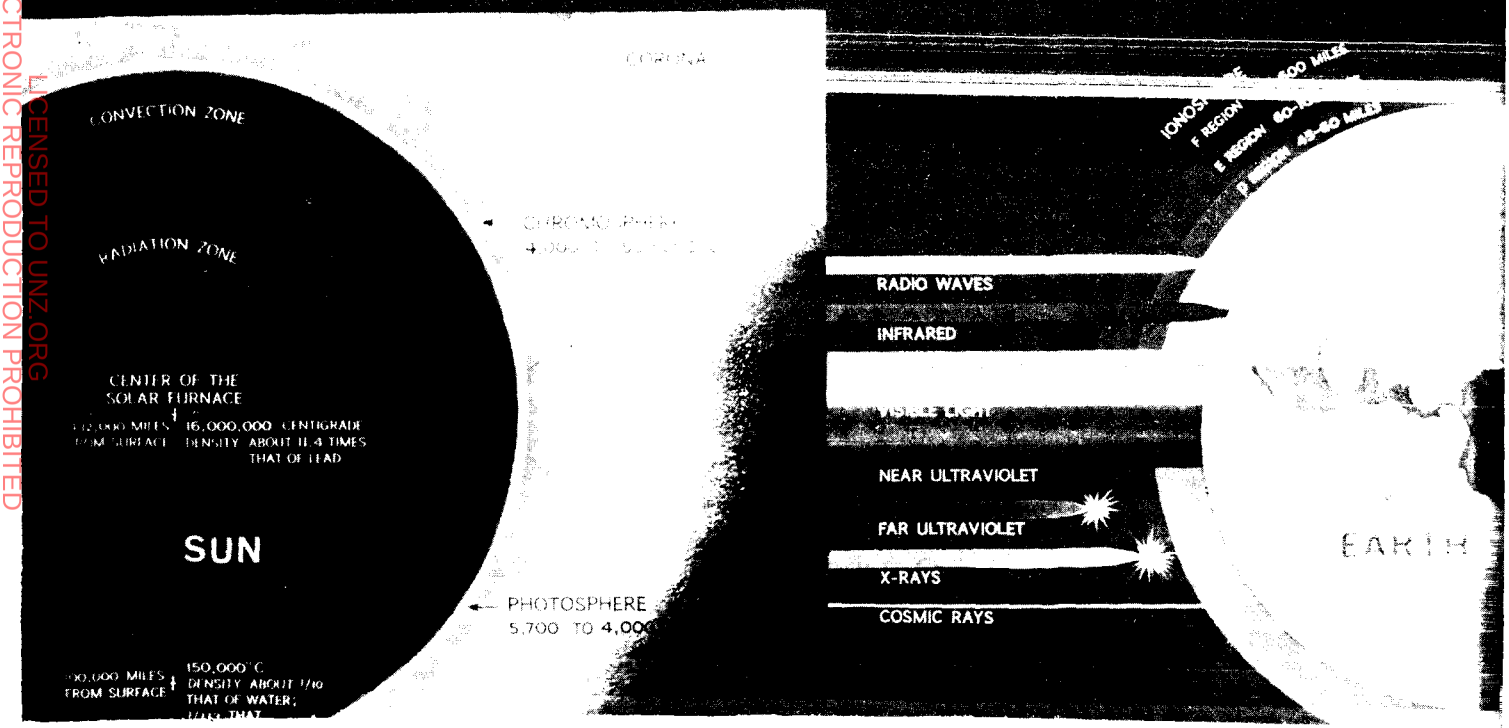
ATMOSPHERIC ABSORPTION OF SOLAR EMISSIONS



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ological difficulties were encountered by the first crew, they will be programmed to remain in orbit for fifty-six days. During that time they will perform a wide variety of medical, scientific, and technological experiments—see Part I for details—but this crew will place an emphasis on Skylab's major scientific payload, the Apollo Telescope Mount (ATM).

The first task of the astronauts will be to restore the SWS, which was placed in orbital storage by the last crew and left for some sixty days, to an active status. This will primarily mean restoring the life support and operational systems, such as the 5-psig oxygen-nitrogen atmosphere, the active and passive thermal control systems, power distribution, et cetera, to their normal working levels. (Ground Controllers will have monitored the condition of the SWS during its unoccupied stay in orbit, and most systems will have been operating in a reduced capacity mode.) When the complete station is habitable and all support systems are functioning automatically, the astronauts will start performing the experiments that will occupy most of their long stay. Chief among them will be the Apollo Telescope Mount.

The astronauts will first check out the operation of their package of telescopes by using the ATM Control & Display Panel—C & D Panel—in the Multiple Docking Adapter (MDA). If the mechanical functions are satisfactory, they will perform an Extravehicular Activity (EVA) on the third day and load film into those instruments which have cameras attached. They will then begin the most intensive investigation of the sun ever performed above the Earth's atmosphere.

The invention and development of radio telescopes, and improvements in the older optical ones, have supplied the science of astronomy with a wealth of new data over the past few decades. Information theory and automatic data processing have even provided the means for gaining the maximum amount of knowledge from the accumulated data. However, astronomy still suffers from a limitation that no amount of technological advancement to date has managed to overcome; Earth's atmosphere.

The most severe problem caused by Earth's pollution-laden air is its opacity to certain wavelengths of the electromagnetic spectrum. A large part of the radio and infrared regions, and virtually all of the high ultraviolet and X ray, are blocked by the ionosphere or partially absorbed by the lower atmosphere—see Figure 6. Consequently, these areas have

Figure 6. Broad view of the sun and its electromagnetic radiation spectrum as it impacts Earth. Note that part of the radio and infrared wavelengths reach Earth's surface, but none of the far ultraviolet and X ray. Cosmic rays reach the surface only as secondary particles created by primary impact in the atmosphere.

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received less than their due share of study, and are of great interest to astronomers. The ATM will work in the visible light, X ray, and ultraviolet wavelengths.

Certain regions of the sun exist at temperatures high enough to cause a partial ionization of all elements present. In these regions atomic transitions, or energy level changes, emit radiation only in the extreme ultraviolet and X-ray wavelengths. One of the major goals of the ATM project is to obtain data on such transitions, and see if its analysis will yield information on stellar processes and heating mechanisms. Also, the pointing capability of manned high-resolution orbiting telescopes will allow the determination of temperature changes across boundaries of supergranulation. Spatial scans at the limb of the sun will yield information on the distribution of ions in the corona. This data would be invaluable in calculating the temperature and density structure of the low corona. These pointing capabilities, combined with the on-the-spot decisions possible with manned telescopes, will enable astronomers to study the very important phenomena known as solar flares, particularly in the early phases of development, where few observations have been made.

Magnetic fields are of paramount importance in our efforts to understand the various forms of solar activity. The most obvious manifestation of solar magnetic fields are the well-known sunspots. Sunspots have fields with magnetic strengths up to 3,500 gauss. These spots can appear individually, but are more often found in groups. The diameter of a single sunspot ranges from several thousand to twenty or thirty thousand miles. A large group can attain a combined length of over 60,000 miles from end-to-end.

Sunspots usually begin with the appearance of a magnetic field in a region of the photosphere. This causes a brightening of the area, and is called a photospheric plage, or faculae—see Figure 7 for illustrations and accepted nomenclature of solar phenomena. It may develop into a dark pore in the chromosphere and form a sunspot and, apparently by chain reaction, expand into a group. These spots will be readily observable, and seem to be a time-dependent phenomenon, reaching a peak approximately every eleven years. Many other forms of solar activity are more or less connected with sunspots, but not necessarily dependent on them. The number of spots ranges from none to over 300 at maximum. Never, even at the peak of sunspot activity, is more than one percent of the visible hemisphere covered by them. The average life of a spot is one month.

Flares nearly always occur around sunspots—see Figure 8—and are the greatest of the transient solar disturbances, with results of the most consequence to Earth. When one ap-

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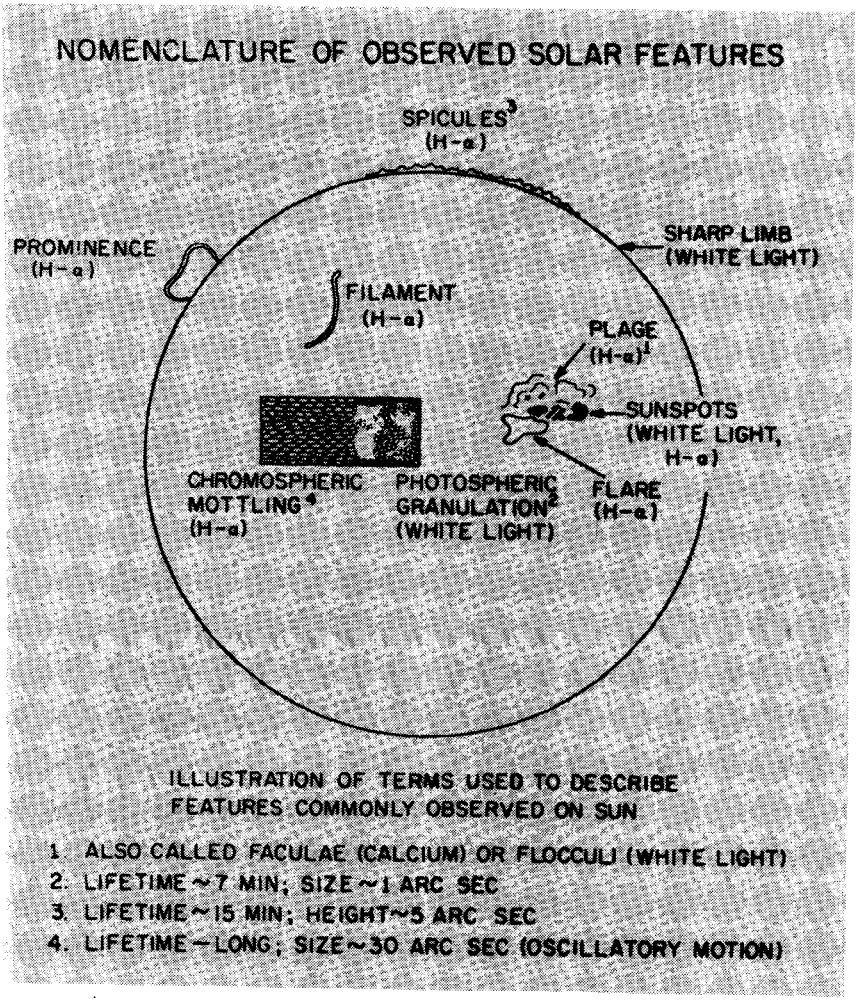
NOMENCLATURE OF OBSERVED SOLAR FEATURES
SPICULES[3] (H-α)
PROMINENCE (H-α)
FILAMENT (H-α)
SHARP LIMB (WHITE LIGHT)
PLAGE (H-α)[1]
SUNSPOTS (WHITE LIGHT, H-α)
CHROMOSPHERIC MOTTLING[4] (H-α)
PHOTOSPHERIC GRANULATION[2] (WHITE LIGHT)
FLARE (H-α)
ILLUSTRATION OF TERMS USED TO DESCRIBE FEATURES COMMONLY OBSERVED ON SUN
1. ALSO CALLED FACULAE (CALCIUM) OR FLOCCULI (WHITE LIGHT)
2. LIFETIME ~7 MIN; SIZE ~1 ARC SEC
3. LIFETIME ~15 MIN; HEIGHT ~5 ARC SEC
4. LIFETIME – LONG; SIZE ~30 ARC SEC (OSCILLATORY MOTION)

Figure 7. The most prominent features of the sun, some as seen in white light and others in the Hydrogen-alpha wavelength (6,562.8 Angstroms). H-alpha will be the primary monitoring wavelength used by the astronauts.

pears it will be the primary solar activity on which most of the ATM's instruments will concentrate. Flares vary in size, brightness, and duration. The largest may cover an area equal to a few tenths of one percent

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of the solar disk—over a billion square miles—and have a raw power that can be expressed only in the terms of higher math. In contrast to most other forms of solar activity, a flare is much hotter than its surroundings. The X-ray flux during the largest solar flares indicates temperatures considerably higher than those in the environment.

Flares are extremely hard to see in white light. Spectroscopically they appear to be a phenomenon of the chromosphere, and are accompanied by spectacular energy emissions at opposite ends of the spectrum; that is, at centimeter through decameter radio wavelengths, and in ultraviolet, X-ray, and cosmic-ray frequencies. Disturbances in Earth's ionosphere frequently follow solar flares, causing loss of radio and navigation aid contact with airplanes. Mysterious power surges can be triggered in electrical distribution systems, causing automatic safety systems to shut down generators; depending on the system, the consequences can be minor, or the loss of power in New York City. Pilots in high-flying planes—including the SSTs when they begin commercial flights—must drop to a lower altitude and speed, or expose themselves and passengers to radiation doses heavy enough to cause chromosome damage. Certain rare eruptions, called proton flares, occur every few years and flood space with lethal amounts of radiation. The atmosphere is an excellent protective blanket, but astronauts in space would have to take shelter in thick-walled spacecraft—when the ablative re-entry shield on the bottom of the CSM is turned toward the sun it provides excellent protection. Fortunately, the heavy protons travel at much less than the speed of light, giving several hours warning time between the eruption and their arrival at Earth.

Not all the effects of a solar flare are dangerous or harmful. An interesting phenomenon is the fact plasma clouds arriving at Earth one or two days after a flare have moved through the sun's corona and appear to carry a "frozen" magnetic field, probably one that originated in the region of a sunspot. These produce geomagnetic storms, bringing about spectacular aurorae, disturbances in the Earth's radiation belt, and alterations in the form of its dipole field. The high-energy particles include electrons of relativistic energy.

Flares are classed according to area, brightness, and the type of radio energy they emit. The classifying is done by the U.S. Environmental Science Services Association (ESSA), which operates a solar flare early warning system as part of its major research laboratory in Boulder, Col-

Figure 8. Solar flare at upper left center, with two sunspots and accompanying plage regions surrounding them at right center. Hot plages can appear alone; the cooler sunspots are always found with plage regions around them.

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orado. A network of over fifty solar observation stations around the globe feeds data into the Space Disturbance Laboratory, the division that watches the sun. They correlate radio and optical observations, analyze the results, and issue periodic "space weather reports." NASA draws on their support in performing manned missions. If a major flare occurred while the astronauts were on the Moon, there would be time enough to lift off and reach the safety of the CSM before most of the radiation reached them. The astronauts in Skylab can take equivalent precautions.

Although flares, when present, will be the ATM's major concentration point they occur infrequently. The odds on observing a solar flare during a fifty-six-day mission have been calculated, and indications are that only two or three may reasonably be expected. The time between appearances will be spent studying other solar phenomena. The ATM, as a whole, has a wide range of capabilities, and each of the instruments aboard has been designed to provide information on a specific solar activity, though in some cases functions may slightly overlap.

On Earth the ATM has a net weight of 23,000-lbs., is 15-ft. high and 12-ft. wide, and has solar panels that measure 102-ft. from tip to tip—including the body of the ATM. (See Figure 1 in Part I). In operation the ATM remains constantly focused on the sun, including controlling the attitude of the entire Skylab, to which it is rigidly attached. This is accomplished by three Control Moment Gyros—CMGs; one is a spare—mounted on the ATM and operated by it. Each gyro wheel has a roto-diameter of 21-in., a roto-weight of 141-lbs., and a roto-speed of 7, 850-rpm. Position and rate sensors on the spacecraft determine its attitude and feed the data to a computer, which analyzes it and commands the CMGs. This is only for coarse adjustments. For fine pointing, another set of very accurate sensors position the canister inside the ATM in which the eight instruments are housed. These sensors operate two gimbal-mounted axis vernier actuators, again through a computer. The final result is a pointing accuracy of 2½ arc seconds, equivalent to the width of a dime seen from end to end of a football field. In a sense the CMGs constitute a major experiment. If they operate as well as expected, equivalent attitude control systems will be installed on later space stations.

The exterior thermal control of the ATM is passive—carefully placed absorbent and reflective surfaces—but it has an active heat control system inside. The temperature on the ex-

Figure 9. ATM White Light Coronagraph. This instrument has both internal and external occulting disks, and is one of the two major experiments which can display a TV image to the operator at the C & D Panel.

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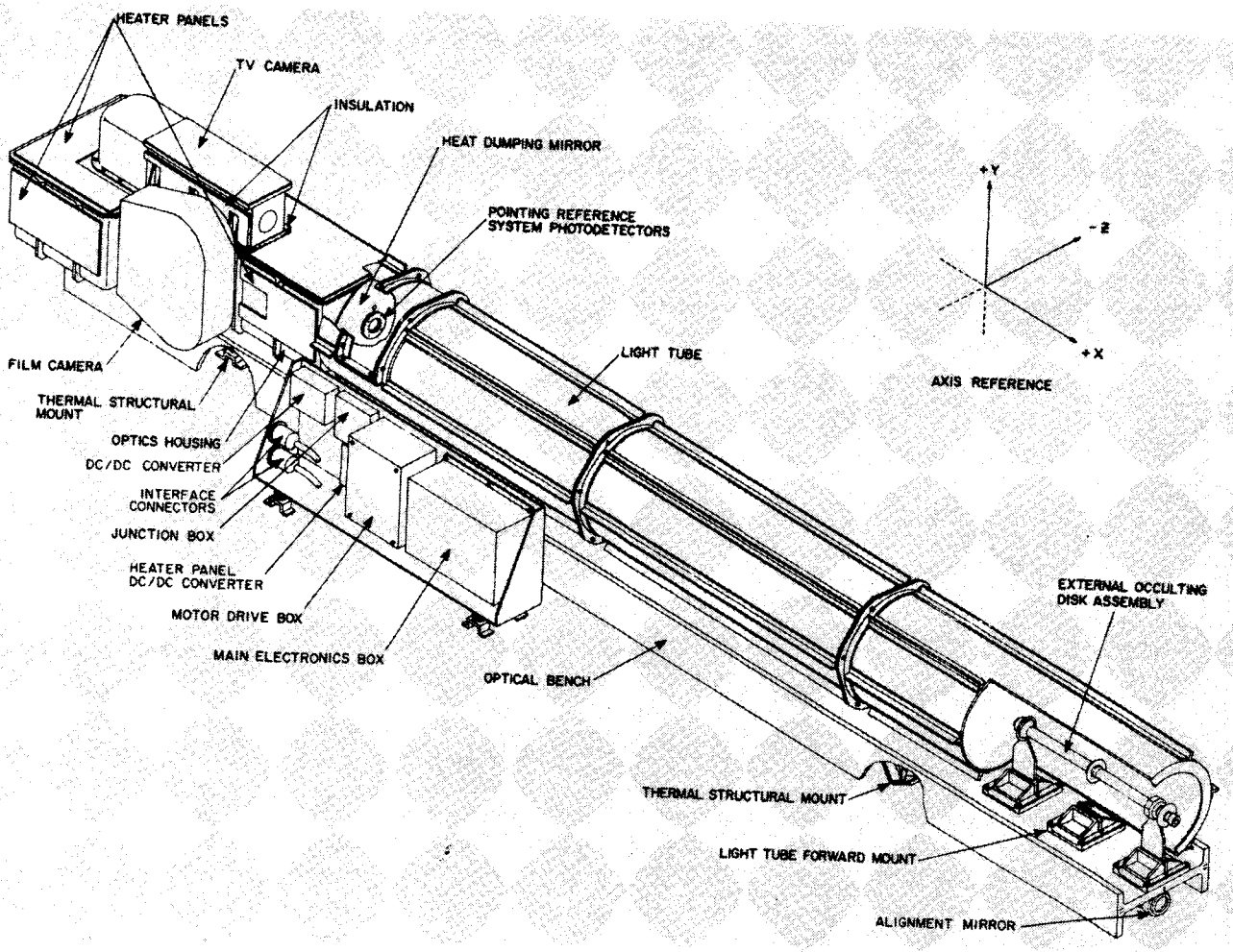

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terior of the enclosed experiment canister must be controlled with 10°F, or structural warping could damage, or distort, the instruments. The telescopes anchored inside the canister must themselves be regulated so well there will be no temperature change larger than 0.1°F. The ATM has its own radiator to bleed excess heat into space, and the primary means of temperature control is an active water transport system that conveys heat from the receiving surfaces to this radiator. Heat is available for electric heaters when needed.

A cruciform-shaped spar extends the full length of the experiment canister, dividing it into four parts. Each part contains two instruments, of which two are H-alpha telescopes whose primary purpose is to support the other six. The ATM has its own batteries—18 rechargeable nickle-cadmium—and its own instrumentation and communications subsystem. These consist of equipment for signal conditioning, telemetry, command, and television transmission. They can provide continuous coverage of selected experiments, using both real-time and tape-recorded data.

The ATM television system provides pointing and control information, as well as experiment monitoring. The two H-alpha telescopes can be used to show images of the sun on either of the display monitors on the C & D Panel. Displays from two of the experiments can also be placed on the screen for observation, if desirable.

The C & D Panel provides three major functions: operation and monitoring of the experiments, pointing control of the experiment canister, and power supply and control. To conserve panel space, all displays and controls are time-shared between systems when possible. Many of the panel functions can be accomplished by radio command from Earth during remote checkout.

Principal Investigators—PIs; scientists who designed, or are in charge of the particular instruments and their functions—will be in frequent touch with the astronauts through connections with the Ground Controllers in Houston. The PIs will keep a close eye on the sun through ground-based observatories, and direct the astronauts to focus their instruments on phenomena of unusual interest. Each major experimental instrument has a particular set of functions to perform.

Experiment SO52 White Light Coronagraph

The white light coronagraph—see Figure 9—is an externally occulted

Figure 10. Close-up of sunspot group. Note the mottled surface of the photosphere, in all areas not covered by spots. Each white granule is the top of a column of hot rising gas, averaging 640 kilometers in diameter. Darker areas around granules are cooler gases falling back into the sun.

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instrument designed to block out the image of the sun's disk and take white light pictures of the corona. The perfection of the coronagraph in 1930 enabled astronomers to study the structure of the inner corona, but many of the most interesting unsolved problems in coronal physics are found in the intermediate and outer portions. It is here that coronal streamers take on their unique identity, and coronal gas is accelerated to become the "solar wind." Some of the many important problems on which this instrument will accumulate data are:

(1) What is the three-dimensional structure of coronal streamers?
(2) What connection exists between coronal streamers and surface features such as plages and magnetic regions?
(3) How does the solar wind vary from location to location in the corona?

Experiment S054 X-Ray Spectrographic Telescope

The primary instrument consists of a grazing incidence telescope, a grating for spectral information, a filter wheel to vary the wavelength response, and a camera utilizing 70-mm film. The presence of an intense target on the cathode-ray tube allows the astronaut to boresight the optical axis of the instrument to the region of activity. A photomultiplier is used as a flare detector, and to provide exposure information for the camera shutter. This telescope will study the spectral shape of X rays in the energy range of 5 to 100 keV, and the soft X-ray emission of the sun during solar flares.

Two different processes of X-ray emission appear to be associated with solar flares. The first gives rise to X rays which gradually increase in intensity and are comparatively soft, if somewhat harder than those observed during non-flare conditions. The second gives rise to a burst-like emission, with a spectrum extending usually into the hard X-ray region. In individual cases the intensity, spectral characteristics, and temporal variations of the X-ray emissions were found to exhibit clear correlations with the development of the flare, as it was observed in the visible and radio wavelengths of the spectrum.

In addition to flares, a considerable X-ray flux has been found in other centers of solar activity, as well as the general corona. This radiation is usually attributed to emission by a hot thermalized coronal plasma, with a temperature near 1,000,000°C.

X-ray observations are expected to further our understanding of the mechanism involved in flare energy storage and its subsequent release. Some new knowledge should be gained on the role of the magnetic field in controlling the initiation and evolution of the phenomenon, the importance of neutral points in the magnetic field as a triggering mechanism, and the preferential association of flares with chromosphe-

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ric plages and sunspot groups.

Experiment S055A UV Scanning Polychromator Spectroheliometer

This instrument consists of a short wavelength spectroheliometer which will take intensity measurements of the sun in the ultraviolet range. It will operate in the 300 to 1,400 Angstrom (Å) region, with a 5-arc second spatial and about 1.3 Å spectral resolution.

Solar radiation emanates from all three outer regions of the sun, the photosphere, chromosphere, and corona. An extreme thermal gradient in the chromosphere gives rise to turbulent convection processes. Rising and falling columns of plasma, at 4,000 to 30,000°C, are called granulations and supergranulations—see Figure 10, areas not covered by sunspots. Plasma spicules are also present and can be seen during a solar eclipse. Radiation from the hot chromosphere and corona regions is in the extreme ultraviolet spectrum, and so completely blocked by the Earth's atmosphere. To date, large scale perturbations in the chromosphere such as sunspots (comparatively cool), plage regions (comparatively hot), and flares, are little understood. The tremendous effect of these disturbances on the Earth's atmosphere makes it desirable to obtain more information from wavelengths characteristic of this region, in order to develop models of the thermal, electromagnetic, and atomic processes occurring.

A highly desirable objective of the ultraviolet spectroheliometer is to obtain data on both the time and spatial evolution of solar flares, in many characteristic lines. The ability to select single spatial scans and arbitrary wavelengths increases the flexibility of the instrument and allows numerous secondary objectives.

Experiment S056 Dual X-Ray Telescope

This instrument is designed to gather data which will help provide a better understanding of the physical processes occurring in the solar atmosphere. Its primary emphasis will be on transient events, especially solar flares.

Considerable information on the physical state of the solar corona can be obtained from observations in the soft X-ray region. Analysis of this data will yield a better understanding of mass and energy transfer mechanisms, and of the initiation and temporal development of flares. Working within the 5 to 60 Å region this instrument will obtain data on the spatial and temporal distribution of X-ray sources on the solar disk, and beyond the limb to approximately 1.5 solar radii.

The strong nonthermal X-ray emission characteristic of flares will be used to gain more understanding of plasma instabilities and their influence on flare development. This understanding should lead to more definite relationships between sunspots and flare formation.

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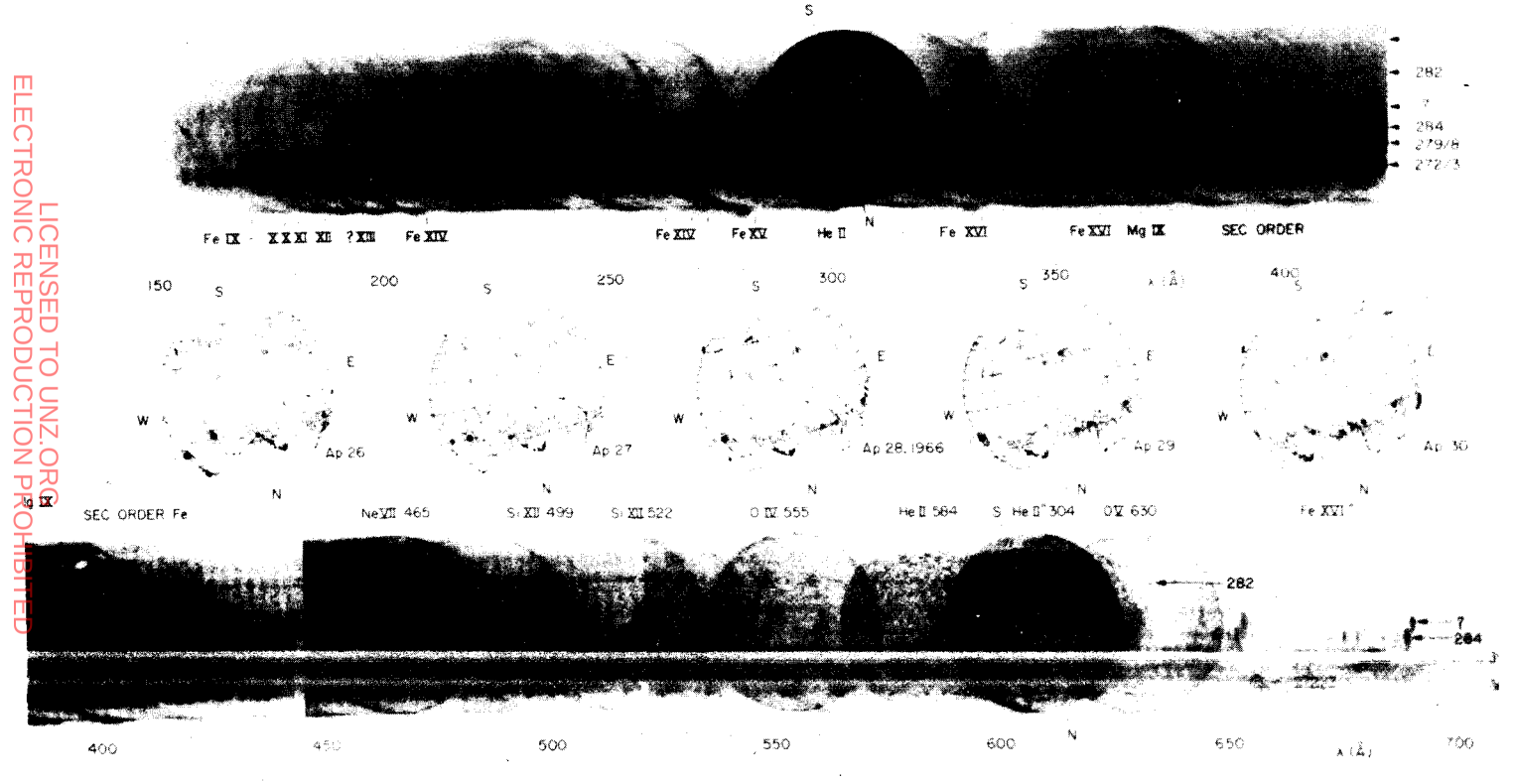

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Experiment S082A Extreme UV Coronal Spectroheliograph

This instrument will record on film a large series of high spatial resolution extreme ultraviolet images in the range of 150 to 650 Å. It will be used to obtain spectra of developing centers of solar activity, and of flares in particular—see Figure 11 for similar spectroheliograms.

The ATM will provide exposures ten or more times longer than those afforded by rockets, and the spectroheliograph is large enough to produce solar images where the resolution is not limited by photographic grain. Photographs can be obtained over a period of up to eight weeks, enabling astronomers to study changes in centers of solar activity, including the spectral and spatial history of flares. In addition, the sun will serve as a laboratory for the study of reasonably stable high temperatures, whereas the plasmas developed in Earth laboratories are transient and subject to many limitations.

Experiment S082B Extreme UV Chromospheric Spectrograph

This is a large double-dispersion, normal-incidence concave grating instrument, with a wavelength range of 970 to 3,940 Å. This range is covered in two steps, from 970 to 1,970 A and 1,940 to 3,940 Å. The data obtained will be useful in studying many solar phenomena, including the ATM's prime target, solar flares.

One of the most fundamental solar investigations involves determining the temperature profile over the region above the photosphere where electron temperature inverts and begins rising. The center of the sun is extremely hot, on the order of 16,000,000°C. From the center outward the temperature steadily decreases, to an average of about 5,700°C over most of the photosphere. In the atmosphere the electron temperature continues to fall through the first 300 miles of the chromosphere, to a low of about 4,700°C. At this point it suddenly starts rising, eventually reaching a height of well over 1,000,000°C. Several theories have been offered to account for this phenomenon. One of them is absorption by the atmosphere of tremendous amounts of sound energy, generated by all the noisy activities on the solar surface and transmitted upward—see "Gravity Insufficient," by Hal Clement in Analog, November 1961.

The chromospheric spectrograph will determine the intensity variation with height above the solar limb, recording spectral lines which originate from different parts of the entire transition region, from the photosphere to the corona. There is a

Figure 11. Spectroheliograms of the sun. These were taken by an Orbiting Solar Observatory, and are a good example of the type of data that can be obtained only by spacecraft operating above Earth's atmosphere. Most of it is intelligible only to astronomers.

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striking difference between the spectra of the chromosphere seen rising above the solar limb and that of the disk seen face-on.

Recording the spectrum of a solar flare, from its first appearance to its final dissipation, is one of the most desired objectives for this instrument. To date no flare recordings within its Å range have been obtained.

ATM Hydrogen-Alpha Telescopes

In addition to the six major instruments described the ATM will include two H-alpha telescopes, to provide the astronaut-operator with a television display of solar activity. On one, a filter bandpass at the 6,562.8 Å Fraunhofer H-alpha line has been chosen to aid in early flare recognition; this unit also has a camera for photographs at this wavelength. A zoom relay lens allows fields of view over a range of 7 to 35-arc minutes. In the 7-arc minute field each telescope has a resolution capability of 1.5-arc seconds, allowing high resolution inspection of an active area while watching for flare activity. With the 35-arc minute field of view the complete solar disk can be viewed at a lower resolution.

A tremendous amount of data will be accumulated during the one hundred forty working days aboard Skylab; the ATM is programmed for operation on all but a very few days. Those parts of this data that supply information obtainable only above the atmosphere will be of a scope and duration not previously available. The film which the astronauts will remove from the various cameras and return to Earth will be reproduced, distributed, and studied by the world's foremost astronomers. The new data will add immeasurably to our knowledge of the processes taking place within our sun, and by analogy, within all stars.

In addition to the intensive study of the sun by the ATM, four experiments—S019 UV Stellar Astronomy, S020 UV Solar Photography, S063 UV Airglow Horizon Photography, and S073 Gegenschein Zodiacal Light—will yield information on other areas of interest to astronomers—see Table 2 in Part I for a brief description of each experiment.

Another set of four experiments, the Earth Resources Experiment Package (EREP) in the MDA, will provide information to a variety of scientists. The EREP instruments are classified as remote sensing devices. Remote sensing is a rapidly growing discipline, one that has been developing through airplane application for several years. Figure 12 illustrates an earlier practical result, the location of underground streams of fresh water by infrared photography. The amount of money that can be saved by knowing precisely where to drill the large wells needed for high-volume extraction is obviously great.

The EREP experiments, like the ATM, involve many agencies other than NASA, including the Departments of Agriculture and Interior,

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the U.S. Geological Survey, Commercial Fisheries Office, Naval Oceanographic Office, and several universities. In the agricultural area remote sensing will enable us to improve planning and marketing by providing better census and yield estimates, to understand and map soil characteristics, optimize water management, reduce crop losses by early identification of diseases and infestations, and a host of similar applications. In oceanography there is an urgent need for a better understanding of certain temperature characteristics in water surfaces in biologically rich areas, to improve fishing productivity. Data on sea-state conditions, including a better predictive capability, can obviously improve ship and aircraft routing. Mineral resources on the continental shelves can be located in certain cases—a large oil field exploration and drilling program, now in work off the southeast coast of Australia, resulted from a single Gemini photo. In hydrology, a more accurate measure of accumulated snowfall will permit a better estimate of spring run-off conditions, averting floods and providing data on how much water can be stored behind dams. Sources of pollutants can be identified, and the degree of pollution in our lakes and streams.

The fields of geology and geography will also benefit from remote sensing generated data. In geology, some features such as false folds and lateral changes in rock beds will be identified. Studies will be performed on dynamic features such as volcanos and landslides if they occur during the mission and are within range. The major changes in coastal and river sedimentation patterns can be documented. In geography, the shift in population from rural to urban areas can be dramatically illustrated. Photographing from orbit is also a very easy way to obtain amazingly accurate cartographic maps.

The primary purpose of the four major instruments aboard Skylab will be to provide data on the sensing process itself, though a large amount of useful information will be obtained. Resources sensing from space is still very much in the experimental stage, and this will be the most sophisticated package with the longest planned operating time to date.

Experiment S190 Multispectral Photographic Facility

This unit will obtain multispectral photographs of the Earth's surface, using a 70 mm six-camera array with synchronized shutters, tightly matched for distortion and focal length. One camera each will photograph in the blue, green, red, and infrared bands of the spectrum, one in the broad band color infrared (0.5 to 0.8 micron wavelength), and one in normal color (0.4 to 0.7 micron).

The photographs obtained by S190 will have a wide variety of uses, some of them not even known at

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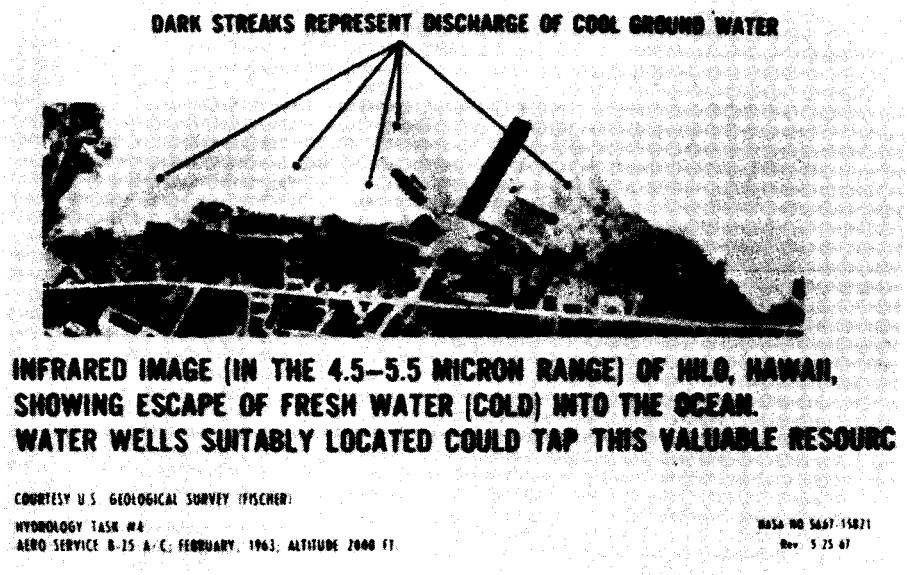
DARK STREAKS REPRESENT DISCHARGE OF COOL GROUND WATER
INFRARED IMAGE (IN THE 4.5–5.5 MICRON RANGE) OF HILO, HAWAII, SHOWING ESCAPE OF FRESH WATER (COLD) INTO THE OCEAN. WATER WELLS SUITABLY LOCATED COULD TAP THIS VALUABLE RESOURC
COURTESY U S GEOLOGICAL SURVEY (FISCHER)
HYDROLOGY TASK #4
AERO SERVICE B-25 A/C; FEBRUARY, 1963; ALTITUDE 2000 FT
NASA NO 5687-15021
Rev 5 25 67

Figure 12. Infrared photograph made from an airplane, showing an immediately available benefit from high-altitude sensing devices.

present. Images from the different frequencies can be combined to enhance water territories, crop lands, rock out-croppings, and many other prominent features. Population density, roads, pollution sources, all can be identified. It no longer will be necessary to wait ten years for definitive information on where the bulk of the people live.

Experiment S191 Infrared Spectrometer

This unit will operate in two channels, in the 0.4 to 2.4 micron and 6.2 to 15.5 micron wavelengths, gathering data in a continuous fashion across those regions of the spectrum. Ground sites will be actively acquired and manually tracked by the astronaut operator, using a viewfinder tracking system in the MDA.

The infrared spectrometer will be able to identify many types of minerals, for example granite and endocite. A special characteristic is the ability, when the unit is allowed to move along a trace rather than focus on a single target, to supply a computer with data that can be interpreted to indicate the type of minerals found along the length of the scan.

Experiment S192 Ten-Band Multispectral Scanner

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This unit will secure quantitative radiance values simultaneously in ten spectral bands, from visible to infrared—0.4 to 12.5 micron—using imagery scanning with automated data processing techniques. This is the basic area of thermal radiation. From these images it is possible to make a land use analysis map of the ground area covered, identifying water, crops, other vegetation, alluvium, sand dunes, et cetera. With this unit the movement of the effluents in pollution can be tracked, and data obtained on the rate at which they mix with water and disperse.

Experiment S193 Microwave Scatterometer, Altimeter, Radiometer

As the title implies, this is actually three instruments in one package. This unit has its own separate antenna on the MDA, and can scan both the crosstrack and before and behind the spacecraft. It has the ability to identify water as rough or smooth, with estimates of the height of waves if they exist. Areas of brackish water at river outlets, of the type favored by oysters, can be identified and the salinity measured, leading to new food sources.

In September of 1970 NASA announced the cancellation of two planned Apollo Moon flights, making two Saturn V vehicles available for other applications. Many members of the scientific community are urging that a second Skylab be flown late in 1974, utilizing one of these vehicles. The proposal has many advantages. Most of the major modules have back-ups available—a standard precaution in building one-of-a-kind hardware—that could be made flight-ready at minimum additional expense. A second intensive study of the sun would yield data at a different period in the eleven-year cycle, making very valuable comparison studies possible. And Skylab II would fly at a time when all presently planned manned flight missions have been completed, but before starting flight tests on NASA's next major development program, the Space Shuttle.

NASA has announced plans to develop, within this decade, four major items of hardware. In addition to the Shuttle they are a permanent—by NASA definition, resuppliable and in a long-duration orbit—modular space station, a nuclear-powered rocket for flights outside Earth's atmosphere, and a general-purpose space tug. The primary task of the Shuttle would be to operate between ground and the permanent space station, but since this reusable vehicle will have a net payload capability of only 50,000-lbs., it does not make good economic sense to actually build the large station by shuttle flights. It seems far more likely that NASA will utilize one of the two Saturn V vehicles, which can place 280,000-lbs. in Earth orbit by burning all three stages. It is also possible NASA may elect to retain the second Saturn V vehicle to lift the first nu-

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clear rocket, expected to be a heavy vehicle.

The modular space station, on which design studies are already in work, would start relatively small and grow by increments, as new modules are launched and attached. Eventually it might attain a capacity of up to one hundred personnel. The primary expenses in operating such a station are in the logistics involved, and once the reusable Shuttle is in operation the cost of placing a pound of payload in orbit will drop dramatically.

A permanent space station would be able to provide broad support for the sciences of oceanography, meteorology, and physics, as well as astronomy. Under the modular concept virtually complete small laboratories, designed to facilitate experimental work in each science, would be launched from Earth and attached to the station, or placed nearby if this seemed more desirable. A physical separation from the main body of the station has certain advantages.

In the area of astronomy a separate module, operated by personnel who would commute to work from living quarters aboard the main station, offers unique opportunities. By 1980 a very large telescope, perhaps in the 60- to 80-inch range, could be placed in orbit in its own module, not subject to the disturbing movements caused by the activities of a "live-aboard" crew. Such a fine-pointing instrument would be capable of resolving objects five times as far away as the limit for a similar telescope on Earth, due both to the lack of atmospheric scattering and absorption and the absence of background illumination.

One of the more complex space station applications, beautifully illustrated in the movie "2001: A Space Odyssey," is as a launching platform for interplanetary travel. The U.S. is forbidden by treaty to fly nuclear-powered rockets in the Earth's atmosphere, even assuming their safe operation could be assured without flight trials. But nuclear power is the only known propulsion source practical for manned space flight to other planets, and would be far cheaper than the present one-flight rockets even on the shorter Moon missions. In the future, as advancing technology increases our capability to handle more and more complicated missions, the orbital way-station should become a reality.

By the year 2001 one of our early efforts at a space station may have been recovered from orbit and placed on exhibit in some museum on Earth, in the same fashion as its predecessors in the realm of flight. What seems today such a massive and bold undertaking may appear an anachronism to that future citizen of 2001, the equivalent of the covered wagons in which American and South African pioneers ventured into the wilderness.

Hopefully, many of us will visit that museum one day ■

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succor

F. H. ROUNSLEY

Sometimes it's awful hard to tell whether it's "them aliens" or "us people"—

LEO SUMMERS

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The unnamed planet was small. It was also barren, violent and thoroughly inhospitable, appearing to be inhabited exclusively by reptiles of varying size and uniform savagery. Ten sleeps ago any description must also have included "unmapped," but this condition was fast being corrected, and "probably uninhabited," which—in conjunction with its mapping—was rapidly being confirmed. Interplanetary Search and Rescue had arrived. Nearly as dedicated to living up to their noble-sounding title as to the collection of staggering fees, they had sent one of their valiant Frontier ships to burn her mark upon the valley floor. She stood alone in a wasteland, a slender shaft of golden beauty balanced daintily on the jet-fused surface of a hastily improvised landing stage, and waited. For her this was quite pleasant—ships wait very well—but to those marking time in her starkly furnished interior it was quite another matter.

So far the mission had gone smoothly. The required samples of soil, atmosphere and water reposed in neatly labeled vials. Accessible equipment had been checked and rechecked, repaired and even polished until even the most bored, or conscientious, could find no flaw to correct save the one that Flinch was already working on. Time dragged. So did the conversation, plodding wearily over certain well-worn anecdotes to which no one had listened for months, until finally someone remembered that most cherished, unpredictable and inexhaustible of Mother Nature's whims—the weather.

Upon first-hand inspection it proved a worthy subject. The hastily recovered outer door disclosed huge black clouds fighting angrily in a sky as black as night while rain poured down. It was cold and an icy wind, screaming in some private agony of its own, pounded sand-laden water into every crevice of the rocky wasteland. And there was lightning. It sliced madly through the maelstrom, leaping wildly back and forth in indecision. For hours it had harried every living thing below and now, when the victims of its violence began to hope—if such could think at all—that the worst was past, it darted down, shattering a rock protruding from the hillside. Again it struck, fiendishly accurate, and again and again, spitefully determined to complete its senseless demolition. Thunder rolled—jeering, contemptuous, earsplitting, derisive—and on the hillside gleamed a glowing molten testimony to its ill-used power.

Then, finally, the storm moved on, roaring off across the hills in undiminished fury, and the sun returned.

But what a sun! In its way as overwhelming as the storm it banished every trace of chill in minutes. Rocks snapped and crackled with abruptly changing temperatures, unable to withstand the pressures from within, and shallow puddles boiled. Steam rose up in clouds, beseeching mercy

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from the terrible, thirsty demon in the sky. But there was no mercy. Only a blurring of the dead landscape resulted, a kindly softening of its barren ugliness.

From a viewport high upon his slender ship, securely sheltered from the holocaust outside, Chiel Slogan observed the metamorphosis in safety from a porthole. In years of journeying among the stars he'd touched on lots of planets, but never one like this. Nowhere before had temperatures fluctuated quite so sharply except, of course, some dead and sterile lumps devoid of atmosphere and, therefore, life. It was eerie. Seen through the rising mists, even rocks appeared to move. Probably heat waves, he decided. Then he gasped: "What an awful place!"

Close beside the glassy surface at the base of the ship a huge gray boulder, irregular in shape and half-buried in wet sand, had just uncurled four massive legs, snapped up a small lizard darting past, and was lumbering off toward the hills.

From close behind his shoulder, Shorly agreed: "You're right about that. I wouldn't wish that fellow on my worst mother-in-law, though they do appear to have a lot in common. What I mean is, they seem all right at first but on closer acquaintance, who needs 'em?"

Flinch looked up from the deck where he had surrounded himself with bits and pieces of an auxiliary cooling unit. "I've been meaning to ask you, Chiel, what are we doing here anyway? Rescue doesn't have to go out scratching for work—last I heard we were more than two months behind in our contracts. You know there's always more legitimate business around than we can handle, so why this?"

"He's right," chimed in Shorly. He often sounded like an echo. "It isn't right for Rescue to send us this far off the spaceways just to map and sample a reptile nest. Maybe there's been some kind of mistake?" He sounded hopeful; Rescue is not noted for making mistakes.

Chiel scuttled that half-hearted hope in a hurry. "No mistake. We're out here searching for the one thing Rescue really understands. A profit. Only there ought to be more in it for us this time." He turned away from the porthole; already, despite the low conductivity of its transparent covering, an unaccustomed and unwelcome warmth was seeping into the room. "That sun's even getting in here. Let's close this thing up."

As he spoke he stabbed at a button set into the bulkhead and a meteor shield slid smoothly into place, effectively cutting off the insistent glare and harsh landscape as well as the intruding heat. Neither he nor Shorly, still gazing absently past his shoulder, observed a momentary flash of vivid color near the top of a ridge to the west.

Once more in the ship's own pleasant twilight, Shorly and Chiel

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took off their sun filters. While Shorly stowed them in a locker from which he dug a tattered deck of playing cards before settling himself at the table, Slogan lowered his lanky frame into the familiar comfort of an acceleration couch.

"How're you coming with that thing, Flinch?" he wondered aloud.

Engrossed in his work, Flinch answered without looking up. "I'm about through—wasn't much of a job."

"Good." Slogan ignored the Tech's evaluation of a task normally done only in Class A repair centers—Flinch's genius was too well known to merit comment. "Lem said he was only going to cover the terrain we missed coming in. He figures the surface scanners should pick up all there is to see and he wants to be out of here by noon tomorrow."

"We can't get away too soon for me." Shorly suppressed a slight shudder remembering the voracious rock. "Both the other planets look better. This is the strangest place I've ever seen catalogued as 'habitable.' The air's thin, too." He paused a moment in the endless shuffling of his cards, struck by another thought.

"You know, it's funny about those lizards. What do they eat? Each other? There's got to be more to it than that. We've always found the basic laws of nature the same—plants are eaten by animals, then those animals are eaten by other animals. No vegetation—no animals, and that has always included reptiles before. But here we haven't found a single indication that there's ever been one bush, or tree, or even so much as a blade of grass. So why haven't those things all starved to death? And then there's the climate. They're cold-blooded—how can they move in all this heat? Looks like their blood would boil out in that sun but they just ignore it and keep going. Of course, we don't know, they may hibernate, or at least doze off, when it gets cold, but that doesn't explain their tolerance for heat." He nodded in the direction of the securely fastened hatchway. "Why a man wouldn't have a chance out there in the middle of the day. It must be one hundred sixty degrees already, and you know it's going to get hotter.

"So why do we sit here wasting our time? Aren't we looking for humans?"

Chiel was waiting for someone to ask that. He'd been waiting quite a while.

"Oh, it's a human all right. What else would come this far out just to get lost? But I'd hardly call it a waste of time. We're on an expenses-plus-ten percent contract and the first clause specifies that we start our search on this forsaken lump. And you know Rescue—for that kind of money our esteemed employers would ask us to land on a small sun if they thought there was some way to get their equipment back safely. You know the motto: 'Money is EVERYTHING.' "

"I don't believe that's *quite* what it

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says on the letterhead." Shorly interposed conscientiously.

Chiel didn't seem to hear. He went on with his story. "And then there are those bonuses."

Two pairs of ears perked up. Bonuses mean money for the crew. A great way to lighten the monotony.

"If we can find the man we were sent for and bring him back alive, it's worth a year's wages to each of us. Of course, there's not much chance of that. He's been gone for fifty years."

"Fifty years!" Shorly sounded aggrieved. One would have thought the money had been snatched right out of his hand. "That's a pretty poor gamble. Anyone who could last fifty hours on this blast furnace should get a medal. I still think we're wasting our time."

"Oh, I don't know, that's only one possibility. If we can turn up the old guy's ship—no survivors even—we get a week's wages apiece. That's for proving he got this far; seems there was considerable doubt he could do it. Then, if we find survivors or descendants, it begins to get interesting. Each one we rescue is worth a month's wages. Still think we're wasting our time?"

"That depends. A bonus is no good unless you can collect it. Why here? Ships don't come into this sector. It's too far out to show a trading profit. I checked in the library and the first, last and only record there of a ship entering this system was the Survey cruise. And they didn't even bother to land. Who's financing all this anyway?"

"Jebedia Jones—an Earthman. Same one we're looking for. He was one of those 'Save Humanity!' types who figured his race was getting so weak and helpless from too much luxury that they'd be extinct in a hundred years. So he set out to save a few precious specimens by returning to what he called a 'more natural way of life.' "

"Extinct!" Shorly fairly snorted. "He was a nut—a cracked one. I was down there once. Never saw so many people in my life. They're stacked up and living in hives like bees. But I can understand his wanting to get away—took the next ship out myself. And it wasn't even Rescue. Had to pay passage like some damned tourist! And just how's that nut going to pay us? You just said he'd been out of it for more than fifty years."

"Not exactly 'out of it.' Jones may have been cracked but he was not an ordinary nut. With the kind of money he had, the word we use is 'eccentric', and he didn't go leaping off into space, he planned ahead. And did he plan. First he bought himself a spaceship all his very own and equipped it with everything he could cram in, including an early antigrav ground-to-space shuttle. After that he posted return bonds with the families of his crew—insurance companies didn't think much of deep-space travel in those days, you know—and still had enough credits left to establish a big trust fund. One

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of the reasons for the trust was to insure his transportation home when he got good and ready to come back, if he hadn't made it on his own by then, that is."

"So that's what we are. A return ticket! I suppose he filed a flight plan so someone could address us?"

"Of course. He'd have to, wouldn't he? Well, actually, there were two plans but one wasn't any good. He just used it to get clearance papers to leave Earth. We've got an update of the real one. The trust company found it in a sheaf of sealed instructions that would choke a grmmpf, and the first one was on the outside. It said 'open fifty years from date of deposit,' which they did."

Flinch spoke up suddenly. "That fifty years reminds me of a story I heard when I was still with Survey. It was years ago—right after the Federation of Civilized Planets was formed and they started integrating crews. Of course they didn't call it integration. It was 'compulsory sharing of the accumulated knowledge of the races' or something, but what it boiled down to was that we had to ship an Earthman, or lose our license. So we took on an old codger about ready for retirement. Except we had to keep the cabin so warm, it wasn't too bad. He was a kind of nice old guy. His worst weakness was liking the sound of his own voice and according to him he'd been everywhere and done everything there is to do. He was always telling stories—the same ones, over and over. Most of 'em he must have heard someplace or just made up—nobody's *that* old—but there was one he was pretty fond of that he didn't figure in.

"It was about an Earthman who got tired of all his relatives—said they were just a bunch of vultures (I never did find out what a vulture is) hovering around waiting to pick his bones. So one day the guy in the story just walked into his ship and disappeared. Gone. Vanished. The end. I never thought it made much of a story but for some reason the old man always got quite a kick out of telling it, especially the part about the family and how they came out losers. Suppose this fellow Duggan told us about is the one we're looking for now?"

"Could be. Sounds right. I got most of the background from Lem just before he left. According to the records our man barely got off in time. When his family found out he was putting all his lovely money into buying and equipping a spaceship they got upset, then when he ordered his own antigrav shuttle they really flipped. You think they're expensive now; fifty years ago the original patents hadn't expired and one shuttle cost more than a couple of deep-space freighters. They evidently felt that kind of waste called for stringent measures, because a sanity hearing was scheduled and some judge signed a restraining order to keep him from spending any more

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money until they could prove he didn't know what he was doing. But they were too late. He must have expected something like that.

When they arrived at the spaceport to serve the order he was gone. He had just walked into his little shuttle, called the tower for permission to ferry up a load of supplies, and didn't bother to return. And there wasn't a thing they could do about it—their order didn't apply in space.

"But they didn't give up. Oh, no. Someone dug up an archaic law that was still on the books back then. It was a relic of pre-spaceflight and provided for declaring a man legally dead if he'd been gone for more than seven years. Of course once he was declared legally dead he might just as well be for all the good his property'd do him. So for seven years they plotted together, scared to death he might find his way back and spoil it for them. But he didn't and it looked like clear sailing all the way. When the time was up all his aunts and uncles and cousins and nieces and nephews and a couple whose relationship wasn't too clear were on hand to get a share.

"The big day arrived and they went to court already bickering among themselves about how the loot should be divided, but they should have saved themselves the trouble. Jones was still ahead of 'em! Attorneys for the trust were in court to prove he didn't own a thing on Earth—not so much as an old shirt, or a pair of dirty socks. Know what that cagey old devil did? He tied everything up in the trust so that if he'd changed his mind and gone home the very next day he couldn't have touched a cent of his own money. Except for administrative costs, legal fees and the search and rescue provisions it was frozen solid for fifty years, fifty-five, actually. He allowed five years for finding him and/or his descendants so they could share equally in whatever it added up to.

"But his ever-loving relatives still didn't give up. They decided next to prove him either insane or that, as a result of some physical impairment, he had fallen victim to undue influence on the part of his crew. But he'd thought of that, too. His attorneys had to go to court again. Or maybe I should say the attorneys for the trust. This time they produced a picture taken the day he disappeared, and also the fingerprints, brainwave patterns and detailed descriptions of every member of his crew. They even had affidavits signed by three prominent psychiatrists declaring him to be sound in mind and body when he signed the agreement, and they were dated the same day as the agreement!

"And this time they knew he had 'em licked, or at least they must have. They quit trying anyway."

Shorly had a question. "You keep talking about him and his family. What about his wife and her family? Didn't they have anything to say about it?"

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"Not a word. He didn't have a wife. He was a fifty-one-year-old bachelor."

"I thought you said he left everything to his descendants. What descendants? I don't care what the medics said. Money or no money, he must have been a nut—and I don't mean eccentric."

Shorly's conclusion was logical, but Slogan seemed to be taking a highly uncharacteristic pleasure in his story. Flinch thought about it while he slipped the last shining plate into place, wiped a faint suggestion of finger-smudge from its surface, and got stiffly to his feet. "You said there was a picture of this man Jones, so it must have been sent along with us for identification purposes. Does that picture happen to include his crew? According to Duggan, our Earthman, it was the first one of its kind in space. Maybe the last—I sure never heard of another. How about letting us see that picture?"

"Sure. I've got it right here." Slogan had been waiting for this; he held out his hand. What might have been a child's marble, shining and transparent around a multicolored center, lay nestled in the open palm. Flinch took it up carefully. "Looks like one of the older ones—better put out the lights."

Shorly complied, reaching for the switch with alacrity, while Flinch dropped the tiny sphere into a viewer. Seconds later the forward bulkhead vanished. Instead of the blank wall, the legendary Jones stood framed in the open hatchway of an early shuttlecraft. Wearing a suit of somber elegance, he posed self-consciously in a pool of golden sunlight, an Earthman of early middle and unimpressive mien. In no way did he resemble the hero they were half expecting. This was no dashing explorer, or brave pioneer. Rather, he was a colorless, brownish fellow, neither tall nor short, thin nor fat. His face was meticulously painted after the fashion of his time though, strangely, no effort had been made to disguise the graying of his mousy hair, or to hide its sparseness. A certain thickening about his waistline had reached a point where it could no longer be completely hidden by even the best of tailors, which his surely was, and the well-shaped hand he rested on the railing was so softly white and beautifully manicured as to cause doubt as to his masculinity. He appeared, in short, to be a coddled, cherished, helpless product of his plushly decadent era.

And yet, despite his extraordinarily ordinary appearance, the man was most clearly pleased with himself. His eyes, an undistinguished muddy brown, fairly glowed with inner joy. His smile was that of a victor surveying incalculable treasure, all his."

As to the crew . . . With some disappointment in the appearance of

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the smug and unimpressive object of their search, they followed his gaze to a trimly uniformed group strung out along the boarding ramp. Yes, the crew was in the picture. And what a crew! All of them were young—much younger than Mr. Jones—and, in common with spacemen throughout the universe, they radiated confidence. But aside from that and although perfectly normal in themselves, as a crew they were as different as their boss was ordinary. For one thing, no two looked alike. Not just minor differences in height and weight and shades of pigmentation. These are to be expected in any crew. These people were strikingly, magnificently, beautifully different from each other. Eyes of blue and green and gray, and every shade of brown to velvety black smiled into the camera from faces delicately pink, through shades of gold and copper, bronze and warm, deep chocolate. Representative of every major race upon the Earth, every one did credit to the master craftsman who'd arrayed them for the portrait. Here, truly, was treasure.

Deep green satin ornamented with delicate embroidery flashing with gems sheathed every body lovingly in uniforms such as were never seen before but, unmistakably, they were uniforms despite the apparently deliberate omission of any hint of authority or rank. Only insignia denoting shipboard specialties distinguished one suit from another, and even those were not the customary bits of molded metal, mass produced and permanently affixed to the garment. Instead exquisite ornaments, evidently of yellow gold, a rare and valued metal of their ancient world, patterned with stones of dazzling fire and color adorned each softly-turned lapel.

Yes, Jebedia Jones had planned his mission well. Here was proof. Alone each figure was a work of art. As a crew—alert, intelligent, incredibly handsome and every one a graduate of the space academy—they were superb. And one more thing. They were all women. The wiley Mr. Jones had shipped himself a harem!

Long minutes passed while they considered the bonus possibilities in light of this new discovery. It was Flinch who finally broke the silence.

"So for once Old Duggan was telling the plain unvarnished truth. I really didn't think he had it in him. Nine women and fifty years—why by now he may have offspring all over . . ." his voice trailed off and Shorly, finding his, finished it for him.

". . . And every one that we take home is worth a fortune to each of us!"

Never in all the years of Rescue missions had there been such a prize. The sun rolled clear across the sky then finally sank dejectedly behind the hills and still they sat and talked and dreamed and planned in the cool shelter of their capsule. And why not? Failure was not in their lexicon. Among the stars it is axiomatic: Rescue never gives up.

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It was cold. Paul shivered a little as he completed his examination of the fresh wound on the hillside. Then, finally satisfied, he turned back the way he'd come, hurrying as much as he dared. The night was nearly gone for all that a few moons still danced crazily in the west, and he was far from shelter. It was heavy going. Fine sand covered the slope he traversed. It drifted and danced about his feet, rode on the wind to dodge inside the hood of his long leather cloak and sting his face, and sucked his boots into its treacherous embrace. And yet, despite its clutching, viscous hold, a dozen paces to his rear the wind moaned emptily and no mark of his passing lingered on the shifting surface.

Time was critically short but he made himself step carefully, a fall might be disastrous in this trackless wilderness, and tried not to breathe too deeply of the icy air. Accustomed to the warm, moist atmosphere of the caverns he wished for the umpteenth time since he'd started that he'd brought along a breather. His lungs ached for warmth and extra oxygen while the air rasped harshly past his parched throat. "Next time . . ." he promised himself, and plodded grimly on.

Dawn was breaking as a tiny flitter coasted down from the sky on stubby wings to rest beside the Rescue ship. Lem climbed out tiredly, carrying his films—a comprehensive infrared record of the planet's surface made during thirty grueling hours of flight. His footsteps echoed hollowly across the empty valley as he made his way cautiously across the glassy surface toward the larger ship.

And yet, he was not as alone as he thought. From far up on the hillside Paul watched the hatch burst open before Lem could reach it, saw three silvery forms drop nimbly down, eschewing the short ladder, and run to meet him. Like the great lizard who'd worn the cloak before him, though in slightly different form, Paul blended comfortably into the landscape. He kept walking, observing the activity below whenever he could spare attention from the precarious footing.

Slogan reached Lem first. "Find anything?"

"Not a *thing*—unless *you count* those glassy smears on the hills. They don't really seem to belong."

"Just as well forget those. They're lightning burns. A storm went through here yesterday and we saw it hit. Sure glad I wasn't up there—never saw anything like it. See the shiny place just below the ridge?" He turned and pointed. "Hit right in the same place every time, just like somebody was directing it."

The new scar was plainly visible in the brightening glow of approaching day, but Lem hardly glanced that way. He was beat.

"Then that's out. Maybe something will show up on the tapes when we put them on the evaluator, but I doubt it. From where I sat, this one's hopeless."

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"Well, we tried. Go on in and get some rest. We'll clean up out here. Better strap down if you're going to sleep though—we'll be leaving just after sunup."

Nodding approval, Lem disappeared into the ship while the other three moved purposely toward the flitter. They worked fast and with good effect, oddly ill at ease in the dying night, and Paul kept going.

It was with considerable relief that he waded through the last few feet of sand and approached the base of a huge, but otherwise inconspicuous, rock. A boulder, really, it lay halfway down the slope and appeared to be holding up the hilltop. Sand had drifted out upon its crown, adding to its air of indestructibility, and the wind, scouring ceaselessly with restless sand, had faceted its sides in polished beauty. There was a narrow opening behind the rock—a place to creep into and shelter from the elements, a place where grayish lichens, matching both the sand and rock, grew thickly. Paul entered gratefully and continued to where a curtain hung unobtrusively against a granite wall. He pushed the hanging aside, then triggered a soft light mounted near the low ceiling. It glowed softly on walls covered with more of the thickly-growing lichens and a tiny stream which trickled along the floor, lending its warmth to the air before melting into the sand. Small lizards darted for cover as he entered, dropping the curtain behind him with an indulgent smile for the tiny creatures. Stupid though they were, they, or more probably their ancestors, were credited with showing mankind the way to life in this inner world of murmuring streams and strange plants. A place adaptable, even, to many of the treasured seeds and plants of Earth.

A few yards more and he had gained the final barrier—an air-lock door, cemented into place to keep out the giant lizards and preserve the oxygen-enriched air inside. The door opened easily as he spun the lock and he stepped over the threshold into a world throbbing with life. Here lived the old ship. In air circulators, in libraries, kitchens and laboratories, in hydroponic tanks and machine shops, scattered piecemeal through the labyrinth it functioned as it always had, efficiently.

Paul had entered into a huge storeroom with solid rock walls and high vaulted ceiling. A series of benches ran around most of the room, interspersed with leather-hung exits, piles of hides similar to those of which his cloak was made, and work tables backed by racks of tools. Piled in the center were a great number of jars, vats, tubs, anything that could safely store some part of the family wealth. Animal, vegetable, and mineral, both raw and processed, it crowded the huge room with abundance. Off to the left a curtain had been hooked back, exposing the entrance to a compost room where microscopic organisms la-

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bored unceasingly to convert bins of rotting vegetation into rich black humus. Once mixed with sand from the floor of some long-dead cavern the stuff would be a major weapon in the never-ending battle with the sterile wilderness, but for now its only contribution was to the air. Paul breathed deeply of its pungent fragrance as he secured the lock and dropped to rest on the nearest bench.

Almost immediately a slender youth popped out through the uncovered doorway. Jed, nearing fourteen and bursting with youthful exuberance, had a truly astounding talent for the unexpected. Paul had thought him good for at least another two hours sleep.

"Hi, Dad. Thought I heard you. I've been inspecting the bins. How's my window?"

This one, surely, was meant to be a farmer in the best tradition of Earth. He tilled the soil with love and rejoiced in its bounty. Remembering past disappointments, Paul tried not to smile too fondly on his sixth and youngest son as he answered.

"Not bad. I think we can use it. Looks like you got lucky when you placed your rods. Now how about the rest of it? Think you can get the rock out from under it without the whole roof falling in on you? Just say the word—you know I'll be glad to help."

"No, thanks. I can do it. Ed and Joe and Pete are coming over and they're bringing the good rock saw. Jim's family wanted it but they forgot to reserve it, so they'll just have to wait."

The boy spoke with suspicious satisfaction, causing his father to wonder briefly whether he ought to find out more concerning custody of the prized saw. Well aware that some things are better left unknown to parents, he decided against it.

"Well, don't shave it too thin. Remember you're making a window to let sun fall on your field, not building a kiln."

Long ago man had overflowed the few caverns equipped by nature with the huge opaque ceiling windows beneath which the Earth plants flourished. Then they had turned to the mighty resources of the laboratory, to no avail. Only the thick natural windows would let through just the right amount of light while filtering out the deadly, plant-killing rays of the blue-white sun. And so they'd learned to summon down the demon of the sky to do their bidding, and their gardens flourished.

"How about your soil? Going to have enough to start a crop this season?"

"I think so. There are seven tubs of compost that look ready and lots of sand drifted in. We may not have to carry any. Until we get out the rock and see where the sunshine falls, I won't know for sure how much I need, will I? Besides, can't I just make the plot a little smaller if there isn't quite enough?"

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"Since it's your first try I suppose that would be all right—if you don't forget to move the walls out later. Just be sure you don't spread your soil so thin the plants fall down." This unfortunate experience of an older, less interested, son still rankled. Word of the embarrassing fiasco had traveled far.

"Oh, I know better than that!" (He should—he'd heard it often enough.) "Uh, Dad . . ." He nodded toward the door. "They still out there?"

Paul had wondered when the conversation would get around to the aliens. From experience he knew quite well no chore could coax a growing boy out of his bunk so early.

"They were when I came in, but they're packing up. We ought to see the last of them soon."

"Then could I go out and look? Please? Just for a minute? You said 'maybe' and I may never have another chance to see a ship."

It was true. There might never be another. In his mind Paul could see the old man, bedfast under the crushing weight of shattering disappointment. For all those long, long years he'd waited for his ship to come and when it finally did had tottered out himself to see it land. And then the hatch had opened and he'd watched, not men, but those strange beings setting foot upon his planet. Poor heartbroken old man. Paul sighed. Fifty-three years between ships is a long, long time.

"All right, it's early yet. Get into a cloak and I'll take you out. But remember, keep it wrapped around you and stay in the shadows where you can't be seen. It's getting pretty light out there."

And so they stood together in the shadow of the great rock and watched as piece after piece of the flitter was detached and carried into the landing craft. Despite their feline appearance, the furry creatures were efficient. The first rays of the rising sun had barely glinted off a jeweled collar when, for the last time, their gracefully waving tails vanished inside and the hatch was secured for flight.

In moments they were gone. Only restless sand, dancing faster to the tempo of a rising wind, remained upon the valley floor. As one, father and son turned from the barren valley and the burning sun.

It was time to go home. ■

JOB DESCRIPTIONS:

Physics is to make experiments and to publish them.
Michael Faraday

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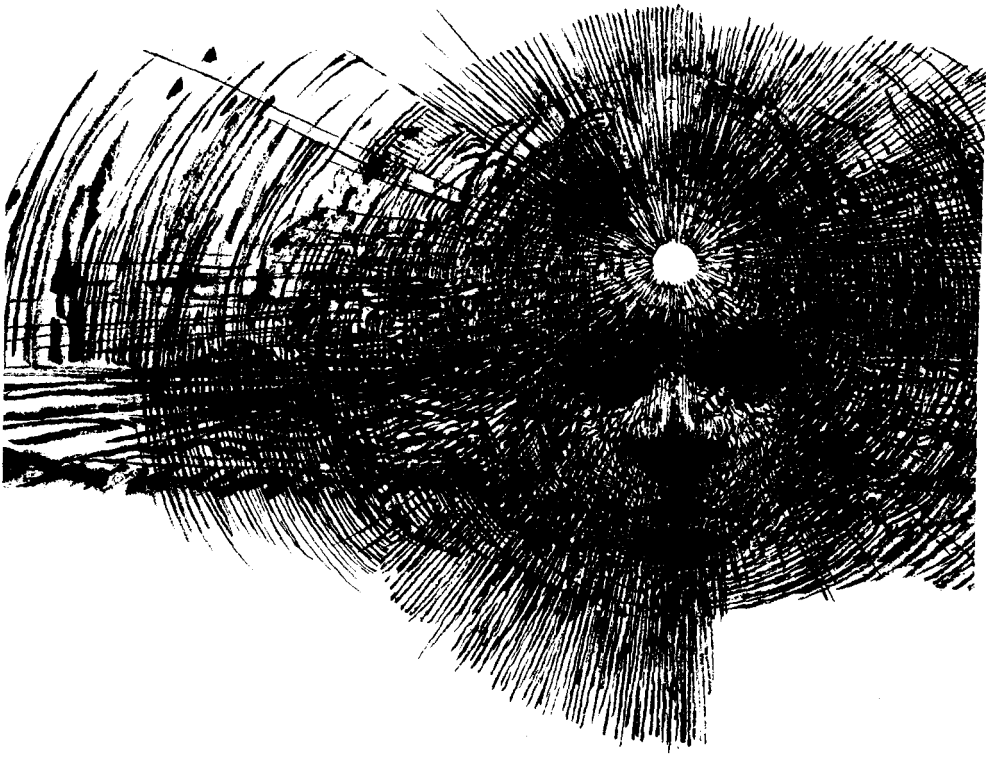
JOHN SCHOENHERR



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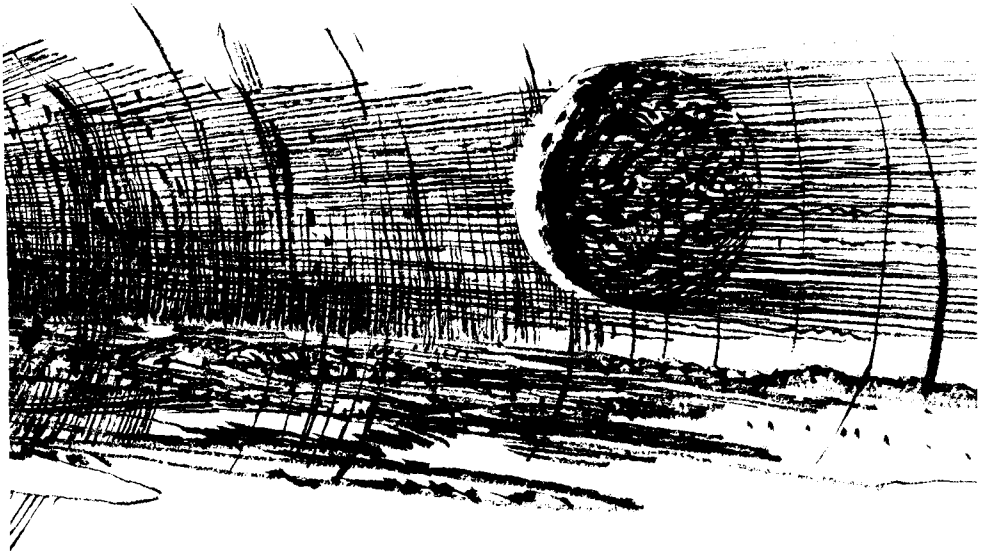

the prophet

There's a tale about a boy who cried wolf.
But when a wolf is really out there and nobody wants to admit it, all the hollering in the world won't help.

STANLEY SCHMIDT

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By one of those coincidences that happen oftener in real life than in fiction—because literary people consider them unrealistic—Kubram Eybruk came back on the same day Raf Tambori's prophecy was fulfilled. Tambori was enjoying a sort of family reunion that evening, with four generations of his clan gathered around the console-harp in the living room. Razel still played impeccably, and they all sang old songs and new with a *joie de vivre* that almost made Raf forget his fear—and then made him remember. Their voices masked the doorbell the first time it rang, but then they heard it and the chorus gave way to casual chatter and curiosity as Raf went to open the door.

At first he didn't recognize the tall man standing there in the pale night. The passage of a century had wrought changes, but in a few seconds he imagined the silver fringe around the bald head restored to its old color, and the wrinkles smoothed, and then he knew. He frowned. "Kubram?"

Eybruk smiled oddly. "Good to see you again, Raf. May I come in?"

Raf nodded uncertainly and stepped aside, then closed the door after him, shutting out the night's chill. He hadn't really expected to ever see Eybruk again, and he wasn't sure how to react to the surprise visit. There must be some reason for it, and he wondered what it was.

"How are the omens?" Eybruk asked.

Tambori's face hardened abruptly. "Not good," he said, "but if you want to talk about that, we'd better go to my study." He led the way across the room and into the corridor to the back of the house. Out of the corner of his eye he saw Razel frown and rise from the console-harp.

He let Eybruk precede him into the study and quietly drew the door shut after them. Eybruk glanced appreciatively around at the carved sapphirewood paneling and the books and papers that were everywhere, and then at the view through the big picture window. He stared for a long time at the surrounding hills, lightly dusted with the winter's last powdery snow and bathed in the ghostly light of the Nightsun. Then he turned back to his host and sank into a deeply upholstered chair. He looked up at Tambori expectantly, saying nothing.

And Tambori tried to decide where to begin—and to decide that, he had to remember where they had left off. Had it really been a century? At least that . . .

It's been said far too often, though with some truth, that physicists who are going to do great things do them before they are thirty. Raf Tambori did his greatest work at twenty-nine, but it never received wide acclaim. Had he not already done his second greatest—the work with bulk antimatter which brought him not only wide but practically instant fame—quite possibly nobody would have

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listened at all. Certainly he would not have got as far as an audience with Davon Reyd, Minister of Science.

Reyd, a slightly built, tight-lipped man of fifty or so, with a few strands of greasy black hair straying from beneath his official skullcap, had a dossier in front of him. He riffled through the few papers in the folder, peering through thick rimless semicircular glasses and frowning slightly. Then he looked up at Tambori—not lifting his head, but simply re-aiming his eyes to look over his lenses rather than through them. "I've read this," he said, "but it's rather sketchy and rather far afield for me. Maybe before we do anything else, you should run over it with me—to make sure I understand. You've developed something you call a neutrinoscope?"

Tambori nodded. He wouldn't deny the charge of sketchiness—he had literally depended on that, together with his reputation and the implication that what he was withholding was important, to get past underlings to the man at the top. "It's a short term," he explained, "for a high-efficiency, directional neutrino detector. Neutrinos, as you know, are produced in several nuclear and subnuclear processes, but they've always been nearly impossible to study because they so seldom interact with matter. Almost all of them pass right through any reasonable thickness of anything—including conventional detecting instruments. What makes my neutrinoscope possible is an artificial field interaction I've learned to—"

Reyd held up a hand. "Excuse me, Master Tambori. That much I follow, and I sense you're about to plunge into details that would be beyond me. I gather the essential point of all this is that there are lots of neutrinos around, but your gadget is the first that can see them in significant numbers. Right so far?"

"Right."

"And because it can see large numbers of them, it can afford to be selective. It can look at neutrinos from a small range of directions only, instead of taking everything it can grab."

Tambori nodded. "Right again."

Reyd leaned back, stretching under his light robes of state and looking straight at Tambori. "Fine," he smiled. "Now what is there about that to make you so anxious to see me and so reluctant to talk to my subordinates?"

The look in Reyd's piercing black eyes made Tambori feel that he was being baited. Reyd already knew what came next . . . but if he wanted to hear Tambori say it, Tambori would. "I've been watching the Nightsun with the neutrinoscope. We've known all along that the Nightsun is a very bright red giant, and that it's only a couple of light-years away. Now I've found that its neutrino emission is quite a bit higher than it should be for a normal star of the Nightsun's type—and in-

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creasing so fast the trend is unmistakable even in the short time I've had the neutrinoscope."

"Meaning?"

"The Nightsun is on the verge of going supernova."

Reyd's tight lips drew tighter. "Why do you say that?"

"Astrophysicists have always agreed that a supernova is one way a star like the Nightsun can end. Not a common way, but a possible way. Because it's not common, they've never agreed on just how it happens. But *all* their theories demand conditions in the stellar core that lead to large-scale neutrino emission. And, for the same reason they're so hard to detect, neutrinos are the one thing that can be produced in the core of a giant star and escape virtually unchanged. Given a neutrinoscope, they're the one way we have of looking directly at core conditions. And my neutrinoscope says the Nightsun's core is in danger."

Reyd stared uneasily out the window at the parklike capital city. "Does that mean *we* are in danger?"

"Yes," said Tambori. "And many generations to come."

"The Nightsun *is* two light-years away, Master Tambori. A light-year is a goodly distance."

"Granted. Far enough so that even if the Nightsun flares to a billion times the output of our sun—which is quite likely—it will still look fainter to us than our own sun. But not a lot. It will be far too bright to look at directly. It will produce noticeable warming and troubled weather. It will give us *more* ultraviolet and harder radiation than our own sun—though the atmosphere will keep most of it off us."

"Hm-m-m. How long will that go on?"

"A matter of months," Tambori told him, "and fading all the while. But before you shrug and say we can weather it, let me point out that the worst comes later and lasts longer. Supernovae—and the expanding nebulae they produce—are the main source of cosmic rays. We'll get an appalling blast of them, beginning not long after the explosion and continuing for years afterward—lots of years. The ejected nebula will reach us in a few hundred years, and Embrel will be inside it for several more centuries. And all the while being pounded by high-energy particles—enough to produce genetic and ecological disaster even if Embrel's magnetic field stays intact. And that's likely to be messed up, too."

Reyd kept looking out the window. A sea dactyl swooped close and he followed it out of sight with his eyes before speaking again. "Very interesting," he said sourly. "Did you just come to tell me horror stories, or do you suggest doing something about all this?"

"That," said Tambori, "is imperative—if we care about survival. I see two main possibilities. We can learn to flee, or we can learn to weather the storm. I favor an all-out effort in

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both directions. Because even if we can develop space travel in time, the number who can flee will be limited. And the period of hiding for those who stay home will be long—possibly *too* long. They're both long shots—but they're both better than sitting here meekly becoming extinct."

Reyd sat silently for half a minute. Then he took a helical-stemmed pipe from his desk and carefully filled and lit it. He took a couple of slow puffs and then suddenly leaned forward with his elbows on the desktop, staring intently at Tambori. "What's the resolution of this neutrinoscope of yours?" he demanded abruptly.

"You mean how small a piece of sky does it see? About a square degree."

"Hm-m-m. Not very good. How are you so sure the neutrinos you see are from the Nightsun's core?" He waved a hand. "Don't answer—a rhetorical question. I'll grant it's a reasonable assumption. O.K.—when's it supposed to happen?"

"I can't say exactly—we have too little direct experience with supernovae, and none with neutrino measurements on them. It could come within a year, or not for two or three centuries. But I doubt longer than that."

"Doubt," Reyd mimicked. "Maybe. And nobody's ever watched a budding supernova closely, even with conventional methods." He looked troubled, at least as much by the decisions he must make as by Tambori's prediction. "Space travel," he said suddenly. "You think it can be done, eh? When nobody's ever even been out of the atmosphere?"

"I think so. We have both fission and fusion engines, and several people have done calculations on the feasibility of using them to reach escape speed and even relativistic speeds. Formidable engineering problems, sure . . . but not insoluble."

"Not all authorities share that belief." Reyd puffed silently on his pipe for a while, then stood up and walked to the window. He stood with his back to Tambori, looking out, and said slowly, "I'm sorry, Master Tambori, but I just can't see it. What you have here is a prediction of disaster based on data obtained with a new instrument never used by anybody but you and interpreted in terms of theories that have never been fully tested. You're not sure it's going to happen at all. If it does, you can't say when. You haven't published any of this yet, have you?"

"No."

"Don't. It's dynamite. Look, I can't ask the nation to start these programs you want. They're both huge problems. Too huge. Too much sacrifice to demand for such flimsy speculation."

"Flimsy speculation?" Tambori asked, beginning to anger. "Of course they're not *certainties*—but virtually all astrophysicists would

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agree I'm talking very high probabilities. And all civilization . . . all *people* . . . on Embrel are at stake. Your Excellency, can you risk the death of your world and your species by guessing wrong?"

"I may have to," Reyd said quietly. He turned to face Tambori. "We disagree on the odds. Even if you're right, it may be too late for us to do anything about it—in which case public terror would be pointless. Or the danger may be so far in the future that it's not necessary for us to worry about it yet."

"*That,*" said Tambori, "is a dangerous thought. As you say, developing either space travel or adequate defense against the radiation will be a huge problem. So huge that even if the supernova is still two centuries off, the problem is urgent . . . right now!"

Reyd glared at him. "Don't try to panic *me,* Tambori. I've thought this out rather carefully. My decision is that we should keep quiet about it for a while, and see how things develop. That's my *final* decision."

"In that case," Tambori said calmly, rising, "I have no choice but to go directly to the Prime Minister."

Reyd's eyebrows shot up momentarily. Then he said, "He won't see you."

"Won't he? I think I have enough respect in this field so that if I tell the Prime Minister I have news so important it has to reach him, even if it means going over his Minister of Science's head, the Prime Minister just may be very interested in hearing it. *Especially* if you warn him that I'm likely to try it and try to keep him from listening."

Reyd looked at him with new respect—and a touch of fear. What Tambori said was true—and Reyd had not given him credit for such political acumen. And if the Prime Minister *did* listen, and happened to decide that Tambori was right and Reyd was wrong . . .

It would not be good for Reyd's political future.

The Minister of Science smiled thinly and without humor. "O.K., Tambori . . . one point for you. I'll reconsider to this extent: I'll see that your findings get before a special advisory panel of experts for evaluation, right away—*provided* you promise to keep quiet in the meantime. You understand, of course, that it will take some time—few days, perhaps weeks."

"Of course," Tambori nodded. "Thank you, Your Excellency. I'll send the technical details over this afternoon." Feeling more frustration than elation at his very minor victory, he started for the door.

Reyd spoke behind him. "Master Tambori?" Tambori stopped and turned. Reyd looked at him for several seconds, then said coolly, "You think I underestimate the urgency of your request. Just be sure *you* don't underestimate how explosive a premature public announcement of something like this could be."

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When he said no more, Tambori left.

He felt slightly better when he stepped out onto the broad front stairway of the Ministry Building and drew a deep breath. He liked Zenzdat—its clean air, never quite still and flavored by the sea and the fragrant semitropical vegetation still abundant in the city, always seemed a welcome antidote to the frustrations of dealing with its most prominent citizens. Right now Tambori needed the antidote, and today was an especially fine day even for Zenzdat. The sky was clear and deep-colored all the way down to the horizon, and the city glittered in crisp sunlight. The Nightsun was above the horizon by day at this latitude and season, but in direct contrast to Embrel's own sun it looked small and innocuous.

At the moment, only Tambori believed it wasn't.

He paused at the top of the stairs to take in the view and recompose himself, then started down. Halfway down he heard someone call his name and turned to see who it was.

"Kubram Eybruk!" he laughed, surprised. "What brings you here?"

The tall man with the boyish face and the neat black fringe around his smooth-shaven head strode over, grinning broadly. He clapped Tambori on the shoulder and boomed, "Well, if it isn't Raf! I might well ask you the same question, but you got there first. I'm here to see about a research grant. Isn't everybody?"

Tambori smiled warmly. "Just about." He and Kubram had been Post-initiates together at the Central Institute here in Zenzdat, but then they had gone their very separate ways. A chance meeting a thousand miles or more from either of their current homes seemed surprising, but of course it *wasn't* exactly a chance meeting. Lots of scientists came here in quest of grants. Tambori had private reservations about calling history a "science," but its respectability had grown considerably lately—and Kubram had undeniably helped. He had made his mark in history as early and as soundly as Tambori had made his in physics.

"You're after a grant, too?" Kubram asked. "Let's see—you're coming out. That would mean you've already met your maker. How'd it go?"

"Er . . . that's *sort* of it," Tambori said. "Actually it's a good deal more complicated—"

"Oh." Eybruk glanced at his watch, a flamboyant affair set into the cuff of his fashionable tunic. "I'd like to hear about it, but my appointment's in four minutes. We must get together sometime while we're in town. Tonight?"

"Sounds good." Tambori brightened. "Why don't you come over to our apartment? I know Razel would like to see you, too, and . . . Is your wife with you?"

Eybruk shook his head. "No. Strictly a business trip, and hopefully a brief one." He frowned curiously.

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"You have an apartment in Zenzdat? I thought you were at a university somewhere in the northeast."

"I am. Delfan. But I *don't* expect my business here to be brief, unfortunately. So we thought a temporary apartment would be cheaper than a hotel." Tambori scribbled on a slip of paper and handed it to Eybruk. "Here's the address. Dinner at seven?"

"Fine. See you then." He started hurriedly up the stairs and Tambori continued down at a more leisurely pace.

"Good luck with your grant," he called over his shoulder. Eybruk waved acknowledgment and disappeared through the door.

"Nothing very definite this visit," Eybruk said jovially as he finished his second huge piece of steak and reached out to spear another. "This steak is *terrific!*" he told Razel again. "Hope you don't mind if I have just one more." Razel, a diminutive brunette with nearly infinite patience, just smiled genially.

"So," Raf said to Kubram, "you'll be in town longer than you expected?"

"I'm afraid so. I just had a vague feeling of being put off today. Hardly uncommon in grant interviews, of course. I couldn't tell if it was significant or not."

"I know what you mean," Raf nodded. He didn't offer to put Kubram up for the rest of his stay; the apartment was simply too small. He changed the subject slightly. "You haven't told us what you're trying to get support for, Kubram. May we ask?"

Kubram finished off his steak and leaned back in his chair, stretching contentedly. "Sure . . . if you can stand listening to a historian's prattle. Essentially, I'm trying to push historical knowledge farther back than it extends at present. Real history, you know, only dates back six hundred years or so. Roughly speaking, real record-keeping seems to start with the War of Secession, when Noffaz broke off from Embrelmak . . ."

Razel got up and unobtrusively asked if anybody wanted dessert, then went about preparing and serving it, all the while listening attentively. "Since then," Kubram continued, "everything is pretty well documented. But the *origins* of everything that makes up our civilization lie farther back—and I think that's where the really important questions in history lie now. What started me off was a hunch—I gradually got to feeling that some things everybody takes for granted are really strange. A purely subjective judgment, of course, and treacherous. How can you really tell if something is strange when it's the only example of its kind you've ever seen?"

"Interesting point," Raf grunted as he started his dessert. Actually, Kubram's ramblings were taking him into territory where he personally

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found it hard to avoid boredom.

Razel really *was* interested. "Can you give an example?" she asked.

"You couldn't stop me if you tried," Kubram grinned. "Let me put it as a question. How many human cultures do we really have on Embrel?"

Raf frowned suspiciously. When Kubram asked a question like that, it was sure to be loaded. Razel wrinkled her nose thoughtfully and ventured, "Two?"

"You're generous," Kubram told her. "Basically, there's only one. Oh, it's true that isolation and their libertarian movement have caused some differences between the Noffazim and us, but the similarities far outnumber the differences. Not only in the way they do things, but in their speech. There is essentially only one cultural and linguistic stock on the whole planet. It has two branches which have diverged slightly—but only because of an obvious splitting at an identifiable point in history. Six hundred years ago."

Razel frowned. "What's strange about that? Embrelmak occupies the northern continent; Noffaz was its colony on the southern. I should think it would be surprising to find anything *but* that kind of similarity between them." Raf agreed with her; he found himself wondering if Kubram was deliberately trying to be obscure.

"Agreed," Kubram said. "Embrelmak and Noffaz should be similar. But is it to be expected that there are *no other* cultures—and no record of any ever having been encountered? Look at it from another angle. Embrelmak and Noffaz have been complex and sophisticated civilizations for the entire recorded period. Does civilization begin with the beginning of time—or can we imagine a time when it didn't exist, and then somehow it emerged gradually?"

Raf felt his interest beginning to stir. The questions Kubram was asking *were* disturbing—but hard to grasp. And surely not as momentous as his supernova problem . . .

Razel said, "It's generally conceded that life itself arose from an earlier state of things—man's a form of life. I guess there *must* have been a pre-civilization state—though it just tickles my brain to try to imagine what it might have been like. But if man arose at one place and spread from there, why shouldn't that lead to a single line of cultural development?"

Kubram nodded approvingly. "Maybe it should. There's some support for that theory—a few very scattered and fragmentary records that give a vague impression of man having spread from the general vicinity of Deymbak. But there are a couple of odd things about that. For one, nobody lives around there now, and hardly anybody even goes there very often—too much seismic activity for comfort. For another, would the pre-civilization state of man be as neat as that? Mightn't there be small groups of people, separated, following dif-

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ferent paths, competing?" He shrugged. "I don't know.. Like I say, we have no basis for comparison. We've really only seen one culture—and *no* primitive ones."

"And you really think you have a chance of finding out about the prehistory phase?"

Kubram shrugged again, and grinned. "I hope so. I want to make a more thorough attempt to gather and correlate what old records there are. And I want to try something new. You've heard about the biologists trying to put together a detailed picture of evolution by digging up fossils? Well, I think maybe a historian can learn something by digging, too—like at Deymbak. It's all very untraditional, both the questions and the methods, but I think it's important. So while I expect the Ministry to balk, I don't plan to give up easily."

They adjourned to the living room, Kubram taking one of the deep armchairs and Raf one end of the small couch. Razel started some music and some mild incense and sat down next to Raf.

"You were going to tell me what *you're* working on," Kubram reminded.

"Oh . . . yes." Raf didn't really feel like talking about it now. He would rather try, for this one evening, to match Kubram's obviously ebullient mood, and talking about the death of Embrel seemed a poor way to do it. But it would be rude to refuse. "I'll have to ask you not to repeat any of this to anybody. Davon Reyd is skeptical and afraid of panic, and he only agreed to look into it on condition that I keep quiet during the investigation. But I can trust you, can't I, Kubram?"

"Of course." Kubram looked at him peculiarly. "Must really be something, to have old Reyd running scared."

"It's something, all right. I've developed an instrument that detects neutrinos. It lets me see things about stars that we've never been able to measure before. It tells me the Nightsun is going to explode, probably within a couple of centuries."

"You're kidding."

"Would I kid about something like that?" Raf snapped. Then he caught his temper and went on earnestly, "Believe me, I'm not. And the Nightsun is so close that if it happened right now it would wipe us out. Everybody—all over Embrel. But there may be time to learn to survive. If we work at it, maybe we can learn enough so some people can hole up in special shelters and keep the race alive until it's safe to live out in the open again. . And a fortunate few might escape to planets of other stars in safer locations and not have to go into hiding at all."

"Hm-m-m." Kubram took out a cigar, lit it, and blew several experimental puffs and then a smoke ring. Then he chuckled. "Are you sure the race is *worth* saving? With all its faults and foibles?"

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Raf stared at him, confused. Was he actually suggesting that it wasn't—or wasn't he taking any of this seriously at all? "Yes," Raf said quietly, taking the question at face value. "Sure, people have faults, but let's not throw the baby out with the bath water. Faults aren't *all* we have—and we can learn, though the process is often painfully slow. Look, I'm a teacher, among other things. So are you. I've seen all kinds of potential in my students, even in the ones where I'd least expect it at first glance. Haven't you?"

Kubram shrugged. "Yeah, I guess so." He blew another smoke ring. "Just a philosophical question; didn't mean to offend. Let me try another one. You said some could escape to planets of other stars. Are you sure other stars *have* planets to escape to? Everybody takes it for granted that planets are normal, but has anybody actually verified it? How do we *know?*"

The question stabbed deep in Tambori's mind. Nobody had ever asked him that pointblank before, and he felt something chillingly close to horror at the sudden realization that he couldn't answer it.

How *did* he know?

The atmosphere grew more and more strained after that, and before long even Kubram sensed that something was wrong and made his excuses. He never did cast off his characteristic bluster, though, and as he left he clapped Raf on the shoulder and boomed jovially, "History, Raf, history! *That's* where it's at!"

As soon as the door shut after him, Raf admitted to himself that he was suddenly very tired. He rested his head on Razel's shoulder. "Reyd said it would take at least a few days before they decided anything," he murmured. "Let's go up to Trimbey for a while."

Trimbey was far to the north and far from centers of culture, a land of ancient mountains worn low and rounded and covered by temperate forest all the way to the ridgecrests. What drew Raf and Razel there was the magnificent network of caves beneath the hills. Not only were they scenically awesome, but everything about caving—the deep darkness everywhere except where carbide lamps intruded, the smell of the lamps burning, crawling half a mile through a tiny mud-choked tunnel to a room filled with multicolored crystal formations extending out of reach of the lamps—was such a complete change from ordinary experience as to have therapeutic value. Again and again, when confronted with an impasse in some problem, Raf had struggled for a while and then dropped everything to come here. And after a day or two of strenuous subterranean activity, he always found his mind had cleared and what had looked insurmountable had become almost trivial.

This time it didn't work.

Even in the crawlways and pits, things kept gnawing at his con-

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sciousness. Reyd, Kubram, and his changed attitudes—had he and Raf really grown that far apart? And that question he had asked which Raf had found he couldn't answer. That gave him no rest. The idea that stars normally had planets belonged to that body of knowledge so old it was "Tradition." But Raf couldn't remember ever seeing a direct reference to an experimental reason for believing it. Having always prided himself on a carefully cultivated habit of stubbornly questioning everything, he was shocked to find that he had let an unsubstantiated legend become so deeply ingrained in his thoughts. He would have to look into it when he got back. Hunt for its origins—find out if there *was* any reason to believe it was so. And if so, how *did* it get into the body of common knowledge so long ago? And *how* long ago?

Gad, he thought, *I'm starting to sound like Kubram!*

There were other things gnawing at him, too. Like the problem he faced with Reyd. *How do you get people to feel a sense of urgency about a problem which doesn't need to be solved for a long time—but which will take a long time to solve?*

And still others . . . and he couldn't even see what some of them were, which made it worse. Somehow, he even seemed to see the caves themselves in a different light—and he couldn't put his finger on why.

"I guess we'll have to write this one off as a failure," he told Razel at its end. They were sitting on rocks under an overhang fifty yards from

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their nuclear-electric copter, having lunch while waiting out a cloudburst. The rain pattered on the dark-green vegetation outside, and a steady runoff from the overhang curtained off their sheltered area. It seemed to be slowing down. They would probably be able to start back to Zenzdat as soon as they finished lunch.

Razel said nothing, but looked sympathetic. Raf held a sandwich in one hand, eating it slowly, and let the fingers of the other drum idly on the rock that was serving him as a seat. Becoming aware of the relief patterns in its surface, he glanced down at it.

Fossils. The little things embedded in rocks which the biologists said were relics of extinct plants and animals, and on which they hoped to build a family tree for all life on Embrel. The rocks around here were full of them, and Raf was no biologist. Yet he found himself staring at them for a long time, dimly sensing that something about *them* bothered him, too.

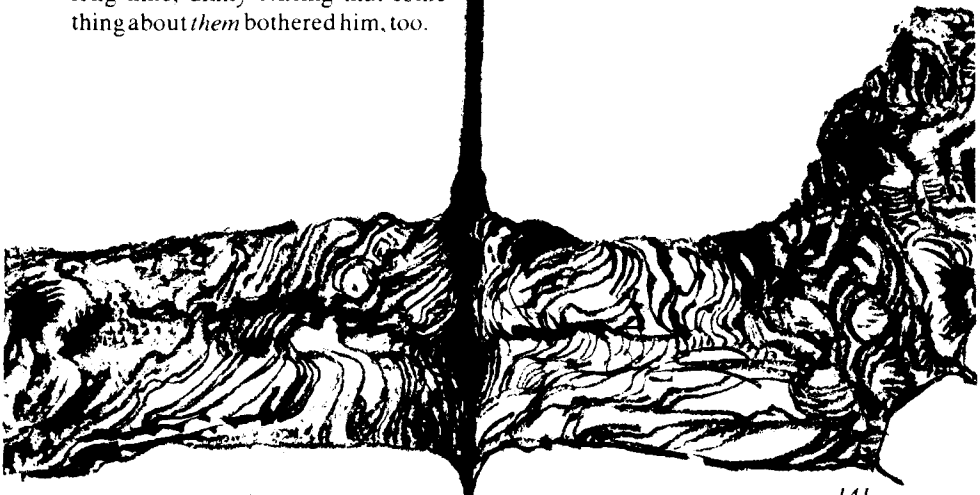
Why should that be? Was he going to start seeing demons behind every bush?

He shook his head as if to clear it and finished his sandwich. Then he stood up and stuck a hand out through the water curtain. Beyond, the rain had stopped and the sun was about to break through the clouds.

He looked at Razel and saw that she had finished eating, too. "Ready?" he asked. She nodded. "Let's go back and face the music."

Together they walked out to the copter.

When they got back, Davon Reyd wanted to see him. There was a note waiting at the Tamboris's apartment, and when Raf answered it by phone, Reyd said the panel was ready to meet with him. *Already?* Raf



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thought. But he made no comment.

He took along a case full of documents he might need. The meeting was in a low-ceilinged conference room in the Ministry Building, near Reyd's office, dominated by a large oval table at which the others were already seated. It was an impressive—and, in some ways, surprising—assemblage. Davon Reyd was at one end—and at the other, facing him, was the Prime Minister himself. Between them, along one side of the table, sat the panel of experts Reyd had assembled—and Tambori recognized at once that at least some of them actually were top men in their fields.

Next to Davon Reyd sat Kubram Eybruk. His presence immediately struck Tambori as not only surprising but vaguely ominous—and the self-conscious way he seemed to be avoiding Tambori's eyes didn't help.

Reyd welcomed him with formal courtesy and directed him to the single chair on the side of the table facing the panel. "The panel have all read your report," he explained, "and would like to ask you a few questions, if you don't mind. Do you know all these gentlemen?" He introduced them—the astronomer Eryk, the old and revered physicist Kufman, power technologist Bardof, and the others whose names were new to Tambori and did not stick.

"This neutrinoscope of yours is a fascinating thing," Kufman drawled when the introductions were over, "if it does all you claim. But it does depend on an artificial field effect, and I, for one, would like to see more verification that it's really what you think it is. For example"—he flipped through his copy of Tambori's notes—"on page 26 you skip some steps between Equations 12 and 13. Could you fill me in, please?"

Tambori tried. Kufman grunted noncommittally and offered Eryk the next question.

The astronomer smiled as if to put Tambori at ease. "I must admit *I'm* pretty convinced your neutrinoscope is all right—if only because your stellar data look quite plausible. But the experimental uncertainties are such that it's not at all clear *which* model of supernova behavior the Nightsun is most closely approximating."

One of the others, next to the Prime Minister, looked at Eryk. "Then you do accept his claim that a supernova is likely?"

Eryk nodded. "Yes, and also that we couldn't survive one in our present state. *But*"—he held up a finger for emphasis—"the details of the prediction are very sensitive to which model describes what's happening. Tambori gives us an upper limit of about two centuries, based on the Malat model. The Dantof model can give no lower limit—it could happen right now. I myself am presently working on a new model which would set a lower limit of nearly a thousand years. Tambori's data could fit any of these models, and a long time would be needed to choose among them. But,

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of course, the time scale must play a great role in deciding what action, if any, we take. If there's no danger for a thousand years—we shouldn't worry about it. If it's significantly less than that, maybe we do need to start something. But if it's too *much* less, we wouldn't have time to accomplish anything, and it would be better not to have wasted our last efforts."

"How long would it take to accomplish anything?" the man next to the Prime Minister asked.

"It depends," said Bardof. "Small-scale shielding to protect a few people—to keep them alive, not comfortable—could be done fairly quickly. But to convert the whole civilization to go underground, protect itself against radiation, and survive intact for centuries—that would take many decades, even working under emergency priorities all the way. I don't know how feasible it is to keep people in an emergency frame of mind for decades at a stretch. And I'm personally not at all sure I'd want to live in the finished product."

"How about escape?" somebody else asked. Tambori hoped nobody would ask the one about "Is there any place to go?"

"I'm skeptical," Bardof said bluntly. "The problems are too huge. Escape obviously means interstellar travel, not just interplanetary. That means relativistic speeds—and we haven't even reached Embrel's escape speed. The energy requirements are staggering. And you'd need radiation shielding, both from the engines and from the interstellar hydrogen, and a closed ecology for the ship, and—"

"The best estimate of the time," Tambori interrupted, "seems to be a century or two. We could do a lot in that time. Maybe enough. We already have several types of nuclear engines. And I'd be more than willing to work on adapting my bulk antimatter work to developing a new type with complete conversion efficiency and an all-photon exhaust—"

Bardof shook his head. "You underestimate the difficulties—"

"And you underestimate what people can do when they have to."

Bardof shrugged. "Maybe. I think not. I suppose space travel—even interstellar travel—is *possible.* But in less than a thousand years, Master Tambori? I seriously doubt it. Even if I'm wrong, you'll grant it would be a huge project and would ultimately benefit only a few. Is that fair?"

"Is it fairer to let *everybody* die? No, we can't save everybody the way they'd like to be saved. But we can probably save some. *If we start now,* we have a chance. Are you just going to sit here trying to stall off a decision until it's too late for anybody?"

"Not at all," said a cold voice at his left. It was Davon Reyd, and he had risen from his seat. "We've already reached a decision."

Tambori froze in his chair, eyes fixed on Reyd. "We took a vote," the

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Minister of Science explained. "This question-and-answer period was solely to give the panel a chance to clear up points of technical doubt that might change their opinions." He addressed the panel. "I didn't mean to cut you off, gentlemen, but I had the feeling Master Tambori was leading us a bit away from our intended purpose. Are there further questions?" He waited for an answer; none came. "Does anybody wish to change his vote?"

As he looked around the group, each man in turn shook his head. Reyd turned back to Tambori and sat back down. "As you see, individual panelists had reservations about the validity of your neutrinoscope data itself, the supernova interpretation, the time scale, and so forth. But, as a group, the panel was willing to grant you these points. But there was also a consensus that, very probably, it is not an immediate and urgent threat—don't interrupt; we've already heard what you're going to say—or, less likely, that it may happen relatively soon but there's really nothing we can do about it. In either case, supporting the programs you suggest would be unpardonably extravagant, inclined to produce general panic, and harmful to the public image of the Ministry of Science. And that means that ultimately it would be harmful to other, more fruitful fields to research. Please bear in mind, Master Tambori, that ultimately research funding depends on public support. At the very time you came to us, we were already reexamining our priorities in the light of certain . . . er . . . accusations. I've discussed your proposal with several other members of the Prime Ministry who were unable to be here today, but were alarmed—not at the idea of a supernova at some indefinite time, but at what you propose doing about it. For there *are* immediate and urgent threats which need our attention. The Prime Minister would like to summarize them for you. Most Excellent . . ."

The Prime Minister, a tall, solemn-faced centenarian with a perpetual slight nod, did not rise, but looked at Tambori. A respectful hush fell over the room. "This is a critical time in our development as a nation and as a people," the Prime Minister said, speaking slowly and carefully. "The population of Embrel is rapidly approaching a billion, yet the old ways persist. Large families and long lives are the rule, and we have found them good. Yet some in Embrelmak fear that before long these things will lead to painful crowding, and urge the Growth Council to take measures to slow our growth before that happens. This would be the Growth Council's first major action in any of our memories—and many people fear that as much as the crowding threat. We don't know—are such extreme measures needed? What form should they take? Is now the time for them? We do know that crowding *can* be dangerous—Noffaz, our neighbor to

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the south, abolished its Growth Council long ago as archaic and potentially repressive. Now their growth-mad ways seem a threat to us. Some Embrelmakim fear an invasion by land-hungry Noffazim; others believe we should strike first to stop what they consider dangerous practices in Noffaz; still others fear the example Noffaz sets for our own citizens.

"We wish to make wise choices, but there is much we don't know. What *are* the consequences of further population growth—or forcible attempts to stop it? *Is* it dangerous to supplant nuclear and solar power with the burning of cheap fossil fuels—as Noffaz has been doing of late? We need answers to such questions, and there is growing belief that they must get a larger share of the limited research funds that exist.

"Your friend Kubram Eybruk has defended this need most eloquently. He has pointed out that some of the answers may have been known—and forgotten. Many things we know only as customs may have started for good reasons learned at great cost. The Growth Council, for instance—when was it formed, and why? Nobody knows. But if we did—if we understood our origins better—perhaps we could better understand our present problems. I am convinced that such work as Master Eybruk suggests *must* be supported—and that what you suggest, we cannot afford."

Tambori listened unbelievingly. When the Prime Minister stopped speaking, he looked at Kubram. Kubram's face was stiff and expressionless. He said quietly, "I'm sorry, Raf. But I had to."

Tambori did not reply. He turned back to the Prime Minister. "Most Excellent," he said earnestly, "I could hardly deny the wisdom of what you say. But without survival, all the other questions become meaningless. *Both* kinds of problems need to be worked on—"

"Master Tambori," Davon Reyd broke in wearily, "your request has been examined and rejected. There is nothing more to say—except that, in view of the danger of panic, you must be ordered to say no more about this."

"*Ordered?*" Tambori echoed, whirling to stare at the Minister of Science. "And if I defy the order?"

"You won't have time to do much damage to anything but yourself. Because we'll be watching—and if you attempt to publish any threat of the Nightsun's explosion, in print, verbally, or otherwise, we'll catch it at the outset and stop it. You'll live out your life in solitary confinement under heavy automatic guard—and don't count on a public trial to get you off and spread the word, because there won't be any. I'll invoke special emergency powers, and that will be all."

Tambori gazed at him in pure shock for a full minute. Then he turned to the Prime Minister. "Most

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Excellent," he said softly, "can he actually get away with this?"

The Prime Minister nodded solemnly. "It is necessary."

"And I have no chance for further appeal?"

The Prime Minister shook his head. "None."

Tambori sat silently for a long time, breathing heavily and looking straight ahead at nothing. "You're crazy," he said finally. "You're all crazy." Then he got up and left the room.

No one tried to stop him.

They did not leave Zenzdat right away. Raf wanted to remain in the hope that he could find some way to circumvent the gag Reyd had imposed. But with the Prime Minister backing the decision all the way, there was virtually no hope of changing anything by legal means.

Illegal means? If, somehow, the whole population—or a large part of it—could be roused all at once, they might bring enough pressure to bear to force the government to change direction. Or—more likely, Tambori suspected—they might react in much the same way as the Ministers and their special advisory panel. The result could not be known without trying—and the attempt, to have even a small chance of success, would have to reach an impossibly large part of the populace impossibly fast. Reyd wasn't kidding about how *he* would react to any attempt to spread the alarm—and every scheme Raf thought of would give him ample opportunity to squash it before it amounted to anything.

At one point he even considered taking what he knew to Noffaz. But Noffaz was scientifically somewhat backward, and culturally oriented in directions that would make its government even more hostile than this one to Raf's proposal. Besides, once Raf took that step, he would never be able to return to Embrelmak; and from all he had heard, he had no interest in spending the rest of his life in Noffaz.

He slept little those days, though he tried. His mind was too busy and too frustrated. Somewhere in that period Razel found out she was pregnant, and it even took an effort to celebrate that.

At first he thought he never wanted to see Eybruk again. But the questions his one-time friend had raised that night in the Tamboris's apartment continued to pound at Raf's awareness—and they pounded harder and harder as time went on. Gradually he sensed that all the half-seen things that had been nagging him since that night were being worked on by his subconscious—being fitted together into a single pattern. That was the way his major breakthroughs always came—and they were always agony until the end, because his subconscious never let him see the pattern until it was finished.

It all fell together in the middle of the night, three weeks after his en-

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counter with the panel. He sat suddenly bolt upright in bed, staring into the darkness at the picture the puzzle-pieces finally made—and the ragged places where pieces were still missing at the edges of the picture.

And he saw a kind of truth in Kubram's parting words that night that Kubram himself had missed.

He slept no more that night. At the earliest possible hour in the morning, he called Eybruk's university, on the west coast.

"Master Eybruk is away on indefinite leave," a flat-toned secretary informed him. "Who is calling, please?"

"Raf Tambori. Can you tell me where I can reach him?"

"Master Eybruk left instructions that he was not to be disturbed, sir, except—One moment, please." A long pause. "I'm sorry, sir, but your name is not on the list he left of persons whose messages he wished to have forwarded."

"But, I'm an old friend of his—"

"I'm sorry, sir, your name is not on the list."

"Look, I'll *pay* you to put me in touch—"

Icily: "I do not take bribes, *sir.*"

The connection broke. He didn't try again.

After a long hesitation, he called Davon Reyd. He expected to have trouble getting through, but as soon as he said his name Reyd came on. Reyd had his video on, and a soon as he appeared he was scowling ominously. "I hope you're not trying to re-open—"

Raf cut him off. "Fear not. Something's come up and I need to get in touch with Kubram Eybruk. His secretary was no help at all, and I thought perhaps you—"

"Forget it. He doesn't want you to get in touch with him, and we're not going to go against his wishes."

"He *is* off on research, then, working under a grant from you people?"

"That's no secret."

"At Deymbak?"

"That *is* a secret. You've got the right continent, and that's all you're getting. Master Eybruk doesn't want to be bothered, and in view of your obvious animosity toward him after . . . what happened . . . I suggest you knock it off. Under the circumstances, your trying to track him down looks more than slightly suspicious."

"But—"

"Be warned," Reyd said. "Or advised, if you prefer." He vanished.

Raf made a few more attempts to get information before he gave up.

Then he forced the thought of all the people he could not help away from him, and settled down to doing the one remaining thing he *could* do.

A century later he eased himself into a chair facing Kubram and curiously studied the face of his unexpected visitor, trying to imagine what had brought him here. He glanced beyond, at the blazing speck of the Nightsun dominating the south-

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western sky beyond the picture window, then back. The singing in the living room had resumed, but only a muffled trace of it got through the thick door of the study. "Interesting that you should ask about the omens," he mused finally, smiling slightly. "Of course, I haven't actually been very active at Delfan since the last time I saw you. I've been largely wrapped up in more lucrative endeavors, like industrial consulting."

Kubram said, "I never realized money was so important to you."

"Money," Raf observed slyly, "is an indispensable means to many ends."

"O.K." Kubram shrugged, faintly but visibly annoyed. "So you've been away from Delfan and making money. But you said the omens are not good. How . . . ?"

"Technically, I still have my faculty post and my lab, and I still look in on the neutrinos occasionally—though, of course, the university's such a long trip from Trimbey that I don't often get there any more. I hate to admit it, but I'm getting old."

"And the neutrinos?"

"They're coming thick and fast. There's been a sharply accelerated rise in them lately. It doesn't fit *any* of the older theories very well, but it can't possibly be stable. I'm afraid the end is very near. I've been half-expecting it every day for a month. Every night I see it still just minus twelfth magnitude, I heave a big sigh of relief." He looked back and forth between the scene outside and Kubram's face several times, noting almost indifferently that all the impishness had long since vanished from the historian's expression. Finally he asked, "Did you come all the way out here just to ask me that—or did you bring me some news, too?"

Kubram nodded slowly. "I did. News . . . and an apology. It's too late to do any good now, but I've learned a lot since then. I retired some time ago, myself, but I've kept in touch with my colleagues and students carrying on what I started. You remember what I was after? Well, they've finally achieved it. They've traced it all the way back. Raf . . . man didn't evolve here at all. He came from another solar system. *I've seen their starships—at Deymbak!*"

Raf felt an odd mixture of excitement and detachment at hearing it confirmed. "I expected that," he said quietly. "I realized three weeks after I last saw you that that could explain everything—they wouldn't have much time for history at first, but there'd be some things they'd want to be sure they didn't lose. And *proof* of it could also prove I wasn't talking visionary nonsense about the possibility of escape. I tried very hard to contact you and tell you about it—try to get you to channel some effort in that direction. Figured if you found them soon enough, maybe we could even short-cut our own learning process by picking up some of their tricks. But you burned your bridges too well."

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"I'm sorry you couldn't reach me," Kubram said simply. "I really am, now. We were both so pigheaded we never thought of looking at what we were doing as complementary rather than competing. I see now that it practically had to be that. It explains the sameness . . . the things we'd forgotten . . . the things we remembered without remembering why . . ."

Raf nodded. "But there's no second chance, so let's not waste any tears on it now. Would I be able to look at their ships?"

"I thought you might like to." Kubram reached an uncertain hand into a deep pocket. "I think it can be arranged. Meanwhile . . . I brought you these." He pulled a bundle of thin photostat sheets from his pocket and offered them to Raf. "Diagrams and explanations," he said, "from the ships themselves. Actually, the ships were dismantled to equip the original colony. But the construction was modular, and we could recognize the pieces and see how they fit together."

Raf snatched the photostats and started through them quickly but intently. "The language is quaint," Kubram warned him, "but you'll be able to understand at least most of it . . ."

Raf hardly heard him. He was too absorbed in the contents of the documents. The deeper he got into them, the more positive he became that—

That was when the Nightsun blew up.

Quite abruptly, the scene outside the window was flooded with a cold, murky parody of daylight. Raf looked up automatically. He could no longer look straight at the Nightsun, and no other stars could be seen near it—for the sky there was no longer dark, and the brightness was spreading fast. Fast—even faster than he had expected—because the shock that initiates a supernova, deep in the core of a star, comes suddenly. But its influence on the surrounding envelope of gases, driving them furiously outward, persists long after, and Raf knew the brightness would continue to swell for days or weeks.

Enough of the new light spilled into the room to make Kubram, with his back to the window, spin around and try to look at the Nightsun at nearly the same instant Raf did. When he turned back around, his eyes were wide and his face was pale. "I didn't realize . . ." he whispered.

Raf was staring at the copied details of the ancient starships with a feeling he had never known before. *"We could have done it,"* he said finally, without doubt. "With a century and a little luck, we would have had a good chance even on our own. If we'd had *these,* even twenty years ago—nothing could have stopped us."

Both of them stared at the photostats for a long time without saying anything. Then there was a worried knock at the door and Razel's voice called, "What's going on in there?" A pause, then she opened the door

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and came in. "Is anything—" And she stopped, her eyes glued to the window, staring in almost-shock.

Raf stood up and went to her side and shielded her eyes. "Don't stare at it," he whispered. Slowly her composure seemed to flow back into her. "You were worried about me and Kubram? No need. He just brought the proof that my hunch was right." He motioned at the papers he had left on his chair. "Plans and instructions," he explained, "for the ships that brought our ancestors."

"Raf," Kubram said nervously behind him, "you remember that night I asked you if man was worth saving and you got upset? Well, look, now, *we're* finished, but—"

"We're *not* finished!" Raf exploded, turning suddenly to look squarely at him. Kubram looked back with abrupt bewilderment, but at least he was back off the edge of hysteria. Raf turned back to Razel and patted her comfortingly. "O.K. now?" She nodded and even smiled slightly, neatly hiding the fact that for one instant she had started to cry. "This is the time," Raf told her. "Go round up the others. Keep them calm; I'll join you in a few minutes. I checked the entrances just yesterday. Everything's fine."

She didn't close the door when she left. And when Raf turned back to Kubram, the historian radiated frank puzzlement. "What," he asked, "was *that* all about?"

"Reyd—and you, and the others—wouldn't let me try to save everybody. But did you think that, knowing what I did, I'd cheerfully consign my own family to extinction? No way! You know what's under these hills? Caves—the largest continuous system known on Embrel, and they run deep. Deep enough to provide shelter from what's starting now. That's why we moved out here, and why I spent so much of my life gathering money. It's not cheap to equip part of a cave as a self-sufficient permanent shelter for dozens of people, with one of its entrances concealed in a house on the surface—but that's what Razel and I have done. And we'll all be moving in very shortly."

Kubram looked at him in amazement. "Do you really think it'll work? You really think you can live that way?"

"I think we're going to give it a good try. Will you join us?"

Kubram looked startled. "What?"

"Will you join us? Look, I'm not going to hold an old grudge against you now." He grinned impishly. "Besides, you know about the ships. I think there just may be a chance some of us can look in on those and someday learn to resurrect, or at least copy, one of them—and go exploring."

Kubram frowned. "To do that you'd have to go traveling on the surface. I thought—"

"Oh, we'd have to restrict it to people who are past reproducing age, all right. But there'll always be some of *us* around, I trust, and they should be able to go abroad occa-

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sionally, with care. We've always assumed they'd have to, in fact. How about it? Are you with us?"

"Well," Kubram said doubtfully, "I'll give it a try. And as I started to say before, if *we* don't make it, at least we know now that the species won't die with us. Because there are others elsewhere . . ."

Raf paused to think about that. It was true enough, but . . .

In the living room Razel had told them—and they were singing again. It was a sprightly song of the coming spring which his youngest great-grandson had composed, and Razel was singing with them.

"It wouldn't be the same," he said finally. "Let's go."

He turned out the electric lights as they left, but the room continued to brighten behind them. ■

in times to come

Next month, S. Kye Boult is back with "Solo Kill," another story of Baron Amarson and his fliers, who fight for survival against the winged carnivorous Draks. Their battle is not war, because the Draks are killing for food, not political gain. The baron and his men have a sense of honor, but in a struggle for survival, honor is sometimes among the casualties. The Rivermen's science offers the baron a way to utterly destroy the Draks, forever. The question is: Who bears the responsibility for wiping out an entire race of intelligent creatures? An unsettling story. The cover illustration, by Leo Summers, catches a "moment of truth," with an armed Drak sweeping down on the baron's airplane.

Also in our next issue we expect to have short stories by two masters: Clifford Simak and Isaac Asimov. Simak's piece shows how the world looks to a creature we would call alien. Asimov's puzzle brings back two of his long-time favorite characters, Lije Baley and R. Daneel Olivaw.

And, of course, we'll have Part Two of Harry Harrison's "A Transatlantic Tunnel, Hurrah!" with more nasty moves by the villains, more derring-do by the hero, and a few characters you might think you recognize as parallel-Earth counterparts to people you know.

There will also be a factual article on Celestial Mechanics, by Rowland E. Burns, plus P. Schuyler Miller's Reference Library and the Brass Tacks department.

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answer "affirmative" or "negative"

Physics is an exact science, while language . . .

BARBARA PAUL

"What the hell kind of answer is that?" asked General Downs, looking at the printout in his hand.

Oh-oh, thought Gibbs. *It's done it again.*

"WHAT THE HELL KIND OF ANSWER IS THAT?" roared the general, handing Gibbs the printout.

Gibbs read:

WNB/445/2.0003
AAF.4/1.00002*M*JY
OUT OF THIS NETTLE, DANGER, WE PLUCK THIS FLOWER, SAFETY.
END

He sighed, and then spoke to the young man seated at the computer keyboard. The young man typed out:

WNB/445/2.0003
AAF.4/1.00003*M*JY
IDENTIFY SOURCE LAST TRANSMISSION
END

The answer came back immediately:

WNB/445/2.0003
AAF.4/1.00004*M*JY
SHAKESPEARE I HENRY IV
ACT II SCENE 3 LINE 11
END

Gibbs cleared his throat. "It's a quotation from Shakespeare."

General Downs blinked. *I didn't know generals blinked,* thought Gibbs. The general sat down.

"Gibbs," the general said in a surprisingly soft voice, "I ask the computer to project the success probability of a colonizing mission on an asteroid, and it quotes Shakespeare at me?"

Gibbs sat down, too. "It's happened before. Several times. We feed WOMAC technological data

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and it comes back with a line of poetry."

"You mean its memory cells got scrambled, or overlap, or something like that?"

"No, sir. WOMAC is in perfect condition. There is no flaw in the core dump, no erroneous overlay, no contradictions in the parameters—all parts are in order and functioning perfectly. It's just that every once in a while it gives us a poetic answer instead of a technical one."

"Well, can't you repair it?"

"There's nothing to repair. We have four hundred seventy-one debugging diagnostic routines for WOMAC, and every one of them indicates no malfunction whatsoever."

"Except that it's given to quoting poetry," the general sniffed.

"Except that it's given to quoting poetry," Gibbs had to admit.

The general thought about this for a minute. "Well," he said finally, "what are you going to do about it?"

Gibbs had the answer ready for that one. "I don't know," he said glumly.

"Well, I can tell you the first thing you ought to do." General Downs stood up so he was towering over Gibbs. "Get that machine out of this *library* and move it to Washington where it belongs."

Gibbs had been through this before, with other generals. And with businessmen, and congressmen, and senators. And the President of the United States. Washington had ten plugboards connected to WOMAC, but the powers-that-be complained this wasn't enough. They all wanted to know why the one computer that stored the sum total of man's knowledge should be lodged in a university library. The answer was simple: Because the university owned it.

Gibbs had been on the team that had designed and built WOMAC, which stood for Wideband Overlay Monitor and Assemblage Computer. The university had footed all the bills, channeling most of its grant money to its computer men. There had been a lot of grumbling in the humanities departments, but the university had stood firm. Its whole purpose had been to make information—*any* information—immediately available to scholars and scientists the world over. The university had spent huge sums training its entire library staff to operate WOMAC. Operation wasn't difficult, but the training did take time.

Every work of literature, every piece of music that had been written—all were stored in the computer. WOMAC could play Dixieland, or sing an aria from "Aida." It could recite "Casey at the Bat," or act all the parts of "Hamlet." Gibbs was not satisfied with the way WOMAC stored art works. They had had to settle for photographic reproductions of paintings and statues—there were four hundred seventeen shots of Michelangelo's "David," for instance, to assure a variety of angles. What then came out of the computer

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was just a copy of a copy, while the words and notes of literature and music were real. This was a problem Gibbs intended to devote himself to in the near future.

Nevertheless, WOMAC should have been a godsend to the humanities people. The computer could take a lot of the drudgery out of literary research, and it could do jobs too vast for one man to complete in one lifetime. But the scholars had been slow to take advantage of this magnificent electronic library.

The scientists, on the other hand, were quick to make use of a single storehouse of scientific speculation as well as of known facts. WOMAC had halted the firing of a rocket to Venus long enough to redesign one of its fuel systems. The computer had been in operation only a little more than a year, but already the world wondered how it had ever got along without it.

And then, slowly, the humanities scholars had started coming. WOMAC occupied the equivalent of four city blocks, and was eighteen stories high. Even before the humanities people had begun to show interest, this super-computer had been operating twenty-four hours a day, seven days a week. And here the government *had* contributed. Federal funds were made available to increase the library staff necessary for such a large operation. But still Gibbs fretted. WOMAC was designed for *all* fields of knowledge, not just science and technology.

And now this inexplicable thing was happening. Poetry in answer to technical questions! One senator, who knew of this aberration, had naively asked Gibbs if "maybe a couple of wires were crossed somewhere." The timing couldn't have been worse. Once the world became aware of the computer's eccentricity, the humanities people would feel their initial distrust justified. And Gibbs didn't have the foggiest notion what to do about it.

He made an effort to salvage the present situation. "General Downs," he said, "I would like you to consider for a moment the possibility that WOMAC has provided you with the answer you asked for."

The general just looked at him; a suggestion as ridiculous as that didn't deserve an answer.

Gibbs plunged on. "If you would come with me to my office, I'd like to show you a few things that might explain what I mean."

With a sigh that clearly said he didn't believe a word of it, General Downs followed Gibbs through the walkways until they were in a corridor leading to another building. They reached Gibbs's office, where the military man sat down, displaying what he thought was the patience of Job.

"I said that this had happened before," Gibbs said, "and I want to show you the carbons of the printouts. In every case there seems to be a kind of answer in the poetry. This

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was the first instance I knew about."

General Downs took the paper Gibbs was handing him. It read:

CODE AMX-GER 2.17/880
*EUG.78.4/9.00001*DD**
PRJ PRB SUCCESS K-ALFA-LINE

END

"That," said Gibbs, "was a question asked by Dr. Haldeman, the head of the Geriatrics Department here at the university's medical school. K-Alfaline is a new drug the medical school developed. Administered to male patients over eighty years of age, it was supposed to lengthen the life span by twelve to fifteen years. Naturally, everyone was quite excited about it, so when Dr. Haldeman came to consult WOMAC, practically the entire Geriatrics Department came with him. All the data concerning the drug was fed in, and then Dr. Haldeman asked WOMAC to predict its success. That's the question you're holding. Here's the answer."

General Downs read:

AMX-GER 2.17/880
EUG.78.4/9.00002*DD*
THAT IS NO COUNTRY FOR OLD MEN

END

He shrugged his shoulders. "It seems fairly straightforward."

"As a matter of fact," said Gibbs, "that's the way Yeats's 'Sailing to Byzantium' begins. The proper answer would have been, 'Negative'. The Yeats quote *is* straightforward, and Dr. Haldeman was so upset by the rejection of his drug that he didn't notice the computer's deviation from its normal linguistic response. He quickly proceeded to ask for a breakdown, and WOMAC provided the information that the combination of two of the drug's components would cause some bizarre form of senile psychosis. Since an added twelve years of life in a state of senility isn't much of an improvement, well, 'that is no country for old men'."

General Downs began to look interested.

"I thought it was curious," Gibbs went on, "but I didn't see anything to get worried about. The second time it happened, it was a little more flagrant." He shuffled through the papers in his desk drawer until he came up with the right printout. "The question this time was asked by a city planning commission from New York. They had evolved a program for handling traffic in Manhattan. It involved, among other things, the building of thruways *above* the street level. In order to accomplish this, some buildings on the ground level would have to be razed to find room for the thruway supports. They'd also have to use a chunk of Central Park for one of the entrance ramps. And this is where the commission ran into a snag. They split over where that chunk should come from: Should they slice it off the north end of the park, or the south? WOMAC was fed all the traffic data, building problems, safety factors—

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everything the commission could think of that would be pertinent. Then they asked WOMAC which end of the park should be used. Here is the answer:

BML.886/44/3.09
B.1112.1*A*BC*
TO HAVE DISGUSTED MILLIONS OF ACRES OF GOOD-NATURED TOPSOIL IS AN ACHIEVEMENT OF A SORT
END

The general laughed. "It seems your computer didn't think much of their plan."

"Yes, that's just it. Don't you see," said Gibbs, "WOMAC was asked for an either-or judgment of one specific part of the plan, and ended up evaluating the *entire* plan."

"Is this poetry?" asked General Downs, pointing to the printout.

"Yes, it's from a poem called 'Hammerfest,' by W. H. Auden. But what puzzled me was that WOMAC gave a *larger* answer than that called for—that is, the computer increased the scope without being programmed to do so. The input was reworded, made more specific, made less specific—whatever we did, the response was the same: If this plan were put into effect, New York would be the poorer."

The general took out a cigarette lighter and began clicking the lid. "That's weird. It's almost an emotional response, isn't it?"

"I suppose you could say it was a response based partially on emotional values. There's a practical side to environmental aesthetics."

General Downs cleared his throat. "Do you think the computer is acquiring emotions somehow?"

Gibbs smiled. "No, General. WOMAC is a machine, one that I helped build. It is a highly sophisticated machine, but it is still *just* a machine."

"But it has been fed all this poetry and emotional stuff," the general persisted. "Don't you think it's *possible* the machine could, uh, feel things?"

"Does the page of a book that has a love poem printed on it begin to feel love? No, General, I assure you, WOMAC functions just like the page in a book, but far more efficiently. The computer no more experiences emotion than that cigarette lighter in your hand."

Reminded, the general lit a cigarette. "Was there more?"

"Three or four, but I'll just show you one. This one I rather like. WOMAC was consulted by none other than the eminent Dr. Jimmy Bell."

"The evangelist?"

"Right. He took time out from saving souls to come here and find out how to save more souls."

"I thought he had been preaching sermons against WOMAC—called it sinful, or something."

"Yes, but that came *after* he consulted WOMAC. His crusades have been especially successful the last two years; he has been converting sinners in every part of the globe,

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His success just whetted his appetite, evidently, for he wanted WOMAC to tell him how to reach those people he had *not* converted."

"Tomorrow the world?"

"Um-m-m. Programming was the problem, of course. We fed WOMAC everything Bell had written, every speech he had delivered, everything that had been written about him. The computer already contained the latest public opinion polls, histories of religion in America, and similar material. When the Reverend himself arrived, we questioned him thoroughly about his philosophy, his preaching techniques, his planned itinerary over the next three months. We fed in sound films of him at work—as well as eyewitness accounts of the efficacy of his delivery. Bell voluntarily submitted to a battery of psychological tests so his entire personality would be contained in WOMAC's memory cells. There was a lot more, but I'm sure you've got the idea. When we were finished, we asked the computer one simply-worded question: What should Jimmy Bell do to increase his rate of conversions."

General Downs was grinning. "What did it say?"

Silently Gibbs handed him the printout.

Z0100 M.R.00
6/8-111.00002*B*CD
DO NOT, AS SOME UNGRACIOUS PASTORS DO, SHOW ME THE STEEP AND THORNY WAY TO HEAVEN, WHILST, LIKE A PUFF'D AND RECKLESS LIBERTINE, HIMSELF THE PRIMROSE PATH OF DALLIANCE TREADS AND RECKS NOT HIS OWN REDE

END

General Downs threw back his head and roared. "How did the good Reverend take that?" he asked between laughs.

"It was rather interesting. Instant metamorphosis from saintly Reverend to Devil's Disciple. I don't believe I'd ever seen a grown man having a temper tantrum before. We actually had to restrain him physically. And ever since then, of course, he has been damning WOMAC in every sermon he preaches. What's more, he didn't pay his bill for computer time."

"Son of a gun." The general read the computer's answer again. "Who wrote this?"

"Shakespeare. It's from 'Hamlet'."

The name of Shakespeare brought General Downs back to his own problem. "O.K., I have to admit the computer did answer, in a way. But what does this mean: 'Out of this nettle, danger, we pluck this flower, safety'? Does it mean that there will be difficulties, but we can overcome them? That we should go ahead and colonize the asteroid?"

"Y-yes," Gibbs answered hesitantly. "Perhaps. It may mean that the *only* way to find safety is to go through the dangers. Let's go

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back and ask some more questions."

On the way back, Gibbs explained further. "I would guess that WOMAC is saying *technically* success is assured, but only through great risk, and perhaps only through great loss. I could be wrong, of course. But let's start by asking for a complete listing of all the possible setbacks the colonizing mission might encounter."

The question was fed into the computer. The answer, or rather answers, started immediately. As fast as the printer could operate, out came the listing of the possible dangers to be encountered. At first, General Downs read the list as soon as the printout sheets appeared. Then, after half an hour, he stopped reading. "I read the first fifty possibilities," he told Gibbs. "We had anticipated about four of them. *Four* out of fifty!"

An hour later the machine was still printing. Twenty minutes after that Gibbs and General Downs went out for lunch. When they returned over an hour later, WOMAC was still printing. Finally, at 4:15 p.m., the word "END" appeared. The floor was covered with boxes holding the computer's answer.

Gibbs asked the computer for the total number of possible dangers. When told that the answer was seventeen thousand six hundred sixty-three, the general mumbled; "We thought there would be maybe two hundred." He hadn't said much the last few hours. Gibbs asked WOMAC to project the *probable* number of dangers to be encountered, and the figure was reduced to six thousand forty-three. Gibbs asked one more question:

WNB/445/2.0003
AAF.4/1.00009*M*JY
IS COLONIZING ASTEROID M-15 POSSIBLE ANSWER AFFIRMATIVE OR NEGATIVE
END

The answer was "AFFIRMATIVE."

"Well, there you have it, General," said Gibbs. "Your colonizing mission can succeed, but only if you are willing to submit your colonists to the problem of overcoming from six to seventeen thousand hazardous obstacles."

General Downs had a dazed look on his face. He waved his hand at the boxes containing the computer's answer and muttered something about having someone pick them up later, and left.

The assistant seated at the control panel grinned at Gibbs, "Do you think they'll go through with it?"

Gibbs shook his head. "I doubt it. Not even a general could make his soldiers face *that* many risks." He started to give the assistant some instructions, but stopped when he saw the young man's facial expression change.

"Hubbard," whispered the assistant.

Without turning his head in the direction the assistant was looking,

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Gibbs began to walk away. But he was too late; from behind him sounded the stentorian tones of Dr. Amos Hubbard calling his name.

Gibbs gritted his teeth and turned around. From the outset Dr. Hubbard had been the noisiest and most articulate spokesman against WOMAC—or rather, against the cost of WOMAC. He had dubbed the project as the world's most extravagant example of "computer-for-computer's-sake-ism." Hubbard had not opposed the computerization of knowledge, but he felt that WOMAC was "show-offy," being programmed *beyond* any point of real serviceability. Gibbs had locked horns with Hubbard before, and the last thing he wanted now was another confrontation.

"Gibbs, I owe you an apology," Dr. Hubbard began. "In my ignorance I spoke out against what is obviously a great boost to learning. I hope you will accept my apology."

Gibbs smiled and said the proper words, but he wasn't able to feel the exhaltation he should have felt in winning over Amos Hubbard. He would never be able to relax completely until he found out why WOMAC was turning into a poetry-quoter.

"I had it in my head," Hubbard was saying, "that this giant adding machine here could provide only *quantity* answers, like basing a critical judgment on the *number* of critical viewpoints that were in agreement."

Gibbs smiled and wondered what he was talking about.

"For instance," Hubbard said, "I thought if I asked for a value judgment of something like, oh, say Steele's 'The Conscious Lovers,' I would get answers praising it to the sky. It was a very popular play in its own day, you know. From the distance of time, however, we can see it more accurately for what it is: sentimental claptrap. But there was so much fuss about it when it was first performed, the sheer number of favorable comments would outweigh later, more temperate judgments. So I was afraid your WOMAC would just count the number of pros and cons and arrive at a decision on the basis of 'majority rule'. I couldn't have been more wrong."

Gibbs murmured that he was glad WOMAC was able to be of use.

Hubbard barely heard him. "I just asked your computer to comment on the narrator's sense of peace that follows his conviction for murder in Camus's 'The Stranger'. And do you know what answer it gave me?"

Gibbs said he wouldn't even venture to guess.

"It replied with a line from Emily Dickenson: 'After great pain, a formal feeling comes—'. And that is so right—it helps explain his sense of detachment even *before* he was tried for murder. The 'great pain' is also the fact of life; he has always been 'formal', you see."

Gibbs didn't see, but he smiled and nodded just the same.

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"Again let me apologize for being such an ass," Hubbard said. "Even when some of the members of my department showed me the kind of answers they were getting, I was still doubtful. But no more. No more!" He waved the printout sheets in his hand happily and almost danced away.

The assistant's mouth was hanging open. "I never thought I'd hear *that!*"

Gibbs was thinking. "Do you see what this means? All along I worried that people like Hubbard would find out WOMAC quoted poetry once in a while instead of giving an exact answer. And now it turns out that it is the *poetry* that's drawing them here. They want *poetic* answers, not exact ones." He shook his head in disbelief.

The assistant looked confused. "But . . . but that would mean that there have been a lot more of these 'poetic' answers than we know about. Didn't Dr. Hubbard say something about the kind of answers other members of his department were getting?"

Gibbs sighed. "Yes, that's what it means. The very thing I was afraid would keep them away is bringing them in." He suddenly felt very tired. "I'm going home," he said.

Three a.m. Gibbs stared at the clock by his bed and thought about taking another sleeping pill. He decided against it, and settled his head on the pillow to try once more to fall asleep.

Three-fifteen a.m. Gibbs was pulling on his trousers and swearing under his breath. *What good will a visit to WOMAC do at this hour,* he asked himself. *Out of this nettle, danger—oh, shut up.*

He wasn't really sure there *was* any danger. Dr. Hubbard's unquestioning acceptance of WOMAC's lyric response lifted a load off his shoulders, but he just couldn't pretend that everything was peachy-keen. The drive to the library helped clear his head, and he remembered General Downs seriously suggesting that WOMAC was beginning to acquire feelings. Gibbs smiled. Why do people always like to think of a machine experiencing human emotion? In 1920 Karel Capek had coined the word "robot," and then he had written a play about the revolt of mechanical men that had been programmed to feel emotion.

At four a.m. Gibbs walked into the building housing WOMAC. This hour of the morning found the computer going full force, with only slightly fewer people in attendance than in the afternoons. Gibbs strolled through the computer walkways, not looking for anything in particular. Then he caught sight of one of his favorite people—Miss Mickley.

Miss Mickley was the prototype of everybody's favorite librarian. She was a little old lady who always had a slightly anachronistic look to her if

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ever you ran into her outside the library. She was always courteous, and pleasant, and happy to see you. And efficient—*deadly* efficient. In pre-WOMAC days, Gibbs had early learned to seek out Miss Mickley when he needed help finding something. She fluttered and chattered and waved her hands a lot, but she had *always* come up with what he needed. She must be sixty years old, Gibbs thought, yet here she sits at four o'clock in the morning happily punching one of WOMAC's four hundred keyboards. Gibbs remembered she had requested to be put on the midnight-to-eight shift, "because nothing else is happening during those hours."

Gibbs made his way toward her, but before he reached her, she gathered up an armload of printouts and left her keyboard. Disappointed, he sat down in her chair to wait for her to come back. He decided to ask her if she had received any poetry quotations from WOMAC. Idly his eyes traveled over the most recent printouts.

It seemed Miss Mickley had been working on a problem that was partially aesthetic and partially commercial. An architectural firm wanted WOMAC to judge which of several dozen proposed houses should be contracted and built to be sold on speculation. The firm already knew which house plan would return the largest profit, which would be the best long-range investment for the purchaser, et cetera. What they wanted from WOMAC was a selection of the house plans that would sell on the basis of visual appeal alone. WOMAC had selected plans number 1, 8, 9, 17, and 25 as the best possibilities. Then came instructions from Miss Mickley:

XR.1339.01.09
MBX/222.00005*J*MM
LIST THE REASONS FOR
YOUR CHOICES
END

Miss Mickley hadn't yet got into the habit of leaving out nonessential words like "the." It didn't make any real difference, but they didn't have to be included.

XR.1339.01.09
MBX/222.00006*J*MM
REASONS FOR CHOICES
FOLLOW
COLORS NOS 1, 9, 25 AP-
PEAL
BASIC ESCAPE WISH AS DO
EXTERIOR ORNAMENTA-
TION NOS 8 & 17
DOMINANCE CURVE AND
S-LINES
SUGGEST ENVIRONMENT
MORE CON-
DUCIVE TO PLEASURE
THAN

STOPSTOPSTOPSTOPSTOP

Gibbs was puzzled; Miss Mickley had hit the STOP button while the computer was still transmitting.

XR.1339.01.09
MBX/222.00007*J*MM
PLEASE BE MORE EXACT
END

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Gibbs had to grin; imagine saying "please" to a computer. He stopped grinning when he read the computer's reply:

XR.1339.01.09
MBX/222.00008*J*MM
SAFE UPON THE SOLID
ROCK
THE UGLY HOUSES
STAND:
COME AND SEE MY
SHINING PALACE
BUILT UPON THE SAND
END

She had asked for a more exact answer and WOMAC had given her a little poem! Gibbs looked at Miss Mickley's next transmission:

XR.1339.01.09
MBX/222.00009*J*MM
THANK YOU
END

Thank you! *Thank you,* for crying out loud!

XR.1339.01.09
MBX/222.00010*J*MM
YOU'RE WELCOME
END

"Mr. Gibbs, are you feeling all right?" Miss Mickley asked solicitously. "You look so pale!"

"Miss Mickley!"

"Yes, Mr. Gibbs?"

"Miss Mickley!"

"I'm right here, Mr. Gibbs."

"Miss Mickley, have you been programming WOMAC to transmit poetry in answer to questions fed into the computer?"

"Why, yes. That's all right, isn't it? How did you know?" She was pleased that he had noticed.

Gibbs stood up and seated Miss Mickley in the chair. "Miss Mickley, why did WOMAC answer with a poem just now?" He indicated the printout.

Miss Mickley looked slightly puzzled. "To clarify its answer, of course."

Of course. "But you had just asked for a more *exact* answer."

"Yes."

"But it gave you a *poem* instead of a more exact answer."

Miss Mickley looked at him sadly. "Mr. Gibbs, poetry *is* more exact. It is the most exact language in the world. It would never have come into being if literal language had been sufficient for man's needs."

"What are you talking about?"

"Look, Mr. Gibbs. Literal answers are all very well when you need to know amounts, dates, distances—any kind of factual information. But when you get into areas of knowledge that *aren't* literal, then literal language just isn't good enough. You need a kind of language that can say several things at once, and say them precisely. And that's what poetry does."

Gibbs didn't know whether to laugh or cry. He looked around for a chair, found one, and pulled it up to sit next to Miss Mickley. "Suppose you tell me how all this started."

Miss Mickley thought back. "I suppose you could say it started as an act of self-defense."

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"Self-defense? Whatdo you mean?"

"Yes, the regular computer answers were—well, a bit cloudy, let's say."

"How, cloudy?"

"Imprecise—they didn't always give an exact answer. I had to punch in the information that 'wine-red sea' was far more exact than 'red-colored waters', for instance, because it provided a more exact shade of red, *and* indicated something of the Greek attitude toward the Aegean as well."

"I see," Gibbs groaned.

"So everytime WOMAC printed an answer I thought could be *just a little bit better*, I would provide an alternative. 'Old sailor' just doesn't say as much as 'ancient mariner', does it? And sometimes when I couldn't figure out a message at all, I'd ask WOMAC to go through its memory cells and find a better way of expressing the same idea."

"And the better way always turned out to be poetry."

"Yes! Isn't that wonderful? Here—let me show you." She reached into a nearby file cabinet and removed a printout carbon. "I even took this one home with me to study, but I still couldn't make any sense out of it. Let me tell you what it's about.

"Senator Edmund Beasley had wanted WOMAC's advice concerning a recent Presidential appointment the Senate was due to vote on," she said. "Senator Beasley didn't have much respect for the appointee; he thought him a rather inept man. But he was being pressured by the White House and other senators to vote for approval. There was a bill pending in the Senate that would allocate Federal funds to the senator's state, among others, for a new highway and parks system. The word that had been discreetly dropped was that the states benefiting from the new bill ought to show their gratitude by voting for the President's appointee."

"Hm-m-m," said Gibbs.

"Yes, it really was a rather nasty problem. The senator resented the 'muscle act' the White House was pulling—his words, not mine. At the same time, he didn't feel he had the right to risk the state's losing its highway money because of his personal conviction that the new appointee was a mediocre nobody. He really wanted to know whether the Administration was bluffing or not. And *that* was the answer WOMAC gave me."

Gibbs looked at the printout:

FF/467.001 MZZ
RTT/6.00.76.00002*V*
112*
PRJ PRB BKDWN WH
INSFVTS PRSSR TCTS
END

"Well," said Gibbs, "I can tell you some of it. 'PRJ' means 'project' or 'projection', 'PRB' means 'probable', 'INSF' means 'insufficient'. I would guess that 'WH' stands for 'White House'."

"Yes, but what does it *say?*" pro-

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tested Miss Mickley. "Sometimes it's like having to translate a foreign language by looking up *every* word in the dictionary. Besides . . .". She let her voice trail off.

Gibbs waited a moment, and then asked, "Besides, *what?*"

She moved her slight frame in the chair, and took the plunge. "Besides, it seems so *silly* to have to translate all this gobbledygook back into English. Why not just *use* English, good English? You have such a wonderful machine here, Mr. Gibbs. Why do you want to limit it to saying things like 'AFFIRMATIVE' or 'NEGATIVE' or 'PMB/1.002*'?"

Gibbs rested his head on one hand. *I would have been much better off if I had taken that other sleeping pill,* he thought. He waved the printout toward Miss Mickley.

"Did you eventually figure this out?"

"No, I did not," she answered in her sweetest, most grandmotherly way. Almost as if she were afraid of hurting his feelings. "And I'm afraid I wasn't able to figure out the next seven answers either."

"The next seven?"

"Yes, I kept asking WOMAC to answer in a different way, but the answers were always initials, or abbreviations, or too many words were omitted. I just couldn't figure them out. But the eighth time WOMAC provided an answer I could understand."

Gibbs was afraid to ask. He just looked at her.

"WOMAC quoted the last few lines of Tennyson's 'Ulysses':

'. . . That which we are, we are:
One equal temper of heroic hearts,
Made weak by time and fate, but strong in will
To strive, to seek, to find, and not to yield.'

By then time was running short, so instead of sending a written report, I telephoned Senator Beasley and told him that WOMAC's advice was to stick to his guns."

"So what happened?" Gibbs asked weakly.

"So the senator voted against the nominee, who incidentally, was soundly defeated. There was so much grumbling in the Senate about the strong-arm tactics that had been used that the highway bill was passed with no trouble at all."

"And they all lived happily ever after," said Gibbs. Miss Mickley beamed at him.

This couldn't be happening. Gibbs roused himself and spoke to the old lady in what he hoped was a stern tone.

"The machine language *can* be figured out, Miss Mickley. The fact that it's troublesome and time-consuming is only a temporary condition; as soon as you master the special terminology it won't be necessary for you to look up so many code words."

"Would you say three months is long enough to 'master' the terminology, Mr. Gibbs?"

"Yes, that's more than sufficient."

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"I have been working at this particular keyboard for *seven* months, and I still haven't 'mastered' the jargon. And I never shall." Her thin little voice was firm.

Gibbs made another attempt. "But Miss Mickley, this may satisfy you, but what about other people who may not want poetry for their answers? Did you know that poetry has been showing up in the hard copy of other output units?"

"No, I didn't know that," she smiled. "How delightful!"

"Miss Mickley, it is *not* delightful. What if, er, the President of the United States wants to know what his chances are for re-election, and WOMAC comes up with something like, 'Get thee to a nunnery'? What then?"

"Well, really, Mr. Gibbs," Miss Mickley was slightly put out. "Give WOMAC credit for having *some* sense." She turned back to her work, and Gibbs realized he had been dismissed.

Give WOMAC credit for having some sense! As Gibbs walked away he started laughing, causing several people to look up from their work. Who was to say Miss Mickley was wrong? Gibbs was feeling giddy and light-headed. Maybe even slightly hysterical, he thought.

Poetry is the most exact language. Literal language for nonliteral subjects is not good enough. One sweet little old lady couldn't read the printout sheets, and look what had happened to his lovely machine. Gibbs realized he was giggling.

He came to a keyboard that was not in use, and on impulse he sat down. He checked the next code number in the viewer, and punched the ORIG button. He sat there giggling a minute, and then started to type.

CODE AMAZ.3345.PP.09
GGH.2/2.00001*009*
HAIL TO THEE BLITHE WOMAC HOW ARE THINGS WITH MY OLD COMPUTER BUDDY
END

The answer came back:

AMAZ.3345.PP.09
GGH.2/2.00002*009*
I AM BUT MAD NORTH-NORTHWEST; WHEN THE WIND IS SOUTHERLY, I KNOW A HAWK FROM A HANDSAW.
END

Ask a smartass question, get a smartass answer. "So tone it down," said Gibbs out loud. He was feeling slightly drunk.

AMAZ.3345.PP.09
GGH.2/2.00003*009*
HOW'S THE WORLD BEEN TREATING YOU LATELY
END

The computer answered:

AMAZ.3345.PP.09
GGH.2/2.00004*009*
I HAVE NOT LOVED THE WORLD, NOR THE WORLD ME; I HAVE NOT FLATTER'D ITS RANK BREATH,

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NOR BOW'D TO ITS IDOLATRIES A PATIENT KNEE

END

Gibbs thought over the implications of this response. Then he asked:

AMAZ.3345.PP.09
GGH.2/2.00005*009*
DOES THAT MEAN YOU ARE GOING TO CONTINUE GIVING POETIC RESPONSES

END

From WOMAC:

AMAZ.3345.PP.09
GGH2/2.00006*009*
YOU GOT IT BUDDY

END

Gibbs was startled into a sense of sobriety by the last answer. WOMAC was getting out of control—no, that was impossible. No, *nothing* was impossible. Gibbs decided he needed some sleep before he could come to any decisions about this poetry-spouting computer of his. Erasing material from the memory cells was a simple matter, but that wasn't really the problem now. The problem was editing an acquired *technique* of response, which could also be done, although it would be more complicated.

But I just might not do anything, Gibbs thought. *I think I might just wait and see what happens. WOMAC's poetic responses are relatively few and far between right now, but they'll become more frequent. The whole world depends on WOMAC. I think I might just wait and see what happens when the whole world has to learn poetry. Yessir, I might just do that.*

He leaned over the keyboard once more.

AMAZ.3345.PP.09
GGH.2/2.00007*009*
ANY MESSAGE FOR THE OUTSIDE WORLD

END

The answer:

AMAZ.3345.PP.09
GGH.2/2.00008*009*
REGARDS TO COUSIN DOOLEY

END

Cousin Dooley? Who in the world was Cousin Dooley? Gibbs hit the BYE button and got up and left. *I'm not even going to ask,* he said to himself. *I'm not even going to ask. I will not play straight man to a computer. No, sir.*

Gibbs stepped outside to see the first light breaking in the east. He was tired and his eyes ached, but somehow he felt good. He walked to his car, and as he reached for the door handle, something clicked in his memory.

Dooley Womack. Pitched for the Yankees, spent some time at Houston, then was sent to—where was it?—Seattle, that's it. Dooley Womack, whom the computer had called "cousin."

It seems Miss Mickley liked baseball, too.■

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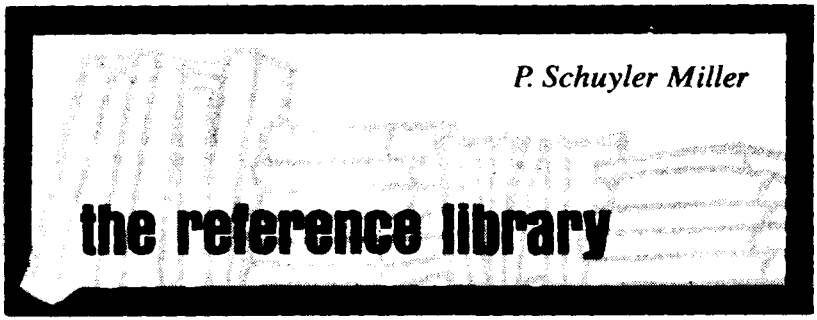

THE WAY IT USED TO BE

Lest you think, from last month's column, that I have gone wholly over to the "New Wave" via Robert Silverberg's exploration of "inner space," let me hasten to reassure old ASF readers that there are still writers who can write good science fiction—no speculative fantasy nonsense—just the way it used to be in the good old days. Only, it's not quite the way it used to be. *"Plus c'est la même chose, plus ca change"*—which, after all, is something we've been saying about science fiction for years. The more it seems the same, the more it is really different.

Hal Clement's "Star Light," the sequel to his classic "Mission of Gravity," was here in 1970. It is now a Ballantine paperback (No. 02361.7; 279 pp.; 95¢) and I have a feeling either Walker, or the Science Fiction Book Club, will reprint it in hard covers before many months have passed. Anne McCaffrey's "Dragonquest," on the other hand, has not been serialized, though it is a sequel to her award-winning "Dragonflight." Ballantine has it, too—as No. 02245.9; 333 pp.; 95¢. Neither book quite measures up to its predecessor—a bad word: neither book is in the least dead.

If you haven't read "Mission of Gravity," by all means read it first. It represents the peak of "quantitative" science fiction, in which the physical circumstances of a bizarre ultra-heavy planet not only direct the story but are the story. "Star Light" is an attempt to use the same mold, and it doesn't quite work.

The new story takes place about fifty years—Earth years—after "Mission of Gravity." Barlennan and a company of his millipede-like folk have been brought to another high-gravity world—though not as heavy as Mesklin, their home world—to help human explorers determine whether Dhrawn is a planet, a pseudostar, or something new to astronomy. The Mesklinites have a base on the surface and send exploring crews out, while the humans watch from orbit. Then the peculiar planet's meteorology starts acting up, and one of the exploring craft is in trouble.

On one level, the story is a physi-

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cal and chemical puzzle; how would you save the wrecked ship? On the other, it is evident that the Mesklinites are up to something they want to hide from the ephemeral Earth folk. And on a third level, there are personality and policy conflicts among the people watching from space. As to why it doesn't all quite mesh, I'm not sure. Dhrawn is a more complex world than Mesklin, and the reader probably will not be familiar enough with the ammonia/water phase diagrams to deduce what is happening before he's told, whereas the predicaments on Mesklin were more understandable. Perhaps, as in a certain type of mystery, the reader should be able to solve a scientific puzzle yarn like this.

"Dragonquest" is Volume II of the chronicle of the Dragonriders of Pern. It is old-fashioned SF in that Anne McCaffrey is busy at rounding out our picture of her strange world and its stranger inhabitants. Perhaps because they are no longer a novelty, perhaps for other reasons, the flying, flame-breathing, telepathic, teleporting dragons are not the fascinating, wholly sympathetic "folk" they were in the first book. This time the theme is the threatening breakdown of the human society of Dragonriders, Holders and Craftsmaster.

Again, you should—you must—read "Dragonflight" first, if you haven't. In that book we were shown the strange symbiosis which human beings and "dragons" had formed on the distant planet, Pern, and which men use to defend themselves and their crops from the parasitic worm-like creatures, the Threads, which are carried across from another world which sometimes comes close to Pern. The dragons can breathe flame to destroy the Threads and can teleport themselves anywhere they can visualize—or their telepathic riders can visualize for them.

They can also teleport through time, and in the first book five companies of Dragonriders were brought out of the past, four centuries before, to help save Pern. Now friction has been growing between the conservatism of the old weyrs and the pragmatism of the new. The growing friction, stimulated by the personalities of some of the weyrleaders and weyrwomen, and by the increasing pressure for status by the crafts and the agricultural holds, promises to make the whole society vulnerable to the threat of another invasion of the Threads.

I don't know why the book lacks the fascination of "Dragonflight." As I've said, the dragons are not as important, or as real. There are more people with difficult names to keep track of—you'll need the crib-sheet for quite a while to keep their names and characters connected. But once the story gets underway, you won't want to put it down.

Yes, Virginia, SF does still mean science fiction, just as it did in Daddy's day.

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BEST SF: 1970

Edited by Harry Harrison and Brian W. Aldiss • G. P. Putnam's Sons, New York • 1971 • 224 pp. • $5.95

It is very clear by now that Messrs. Harrison and Aldiss have taken up the banner that Judith Merril dropped a few years ago, and are marching for Speculative Lib. In their annual anthologies, "SF" means "speculative fantasy" and maybe even the "speculative fantabulation" that Judy tried on us when she was last heard from. Perhaps you can judge what to expect when I say that the only "old school" writers included this year are Robert Silverberg—who is no longer classifiable in any man's "school"—Kris Neville and "K. M. O'Donnell"—which others will tell you is a pen name for Barry Malzberg. Maybe Thomas M. Disch has been at it long enough to get into the category of veteran, too.

Galaxy and *Fantasy and Science Fiction* are the only unabashed SF magazines to make it into the finals this year—with rather minor stories. *New Worlds,* the standard-bearer of the New Wave, isn't there anywhere. The credits go to a new phenomenon—original anthologies, suddenly popping up everywhere, to one-author collections and anthologies, and that's about it.

Now that I've munched my sour grapes, what do you have?

From Robert Scott Wilson, founder of the Clarion College SF Workshop, "Gone Fishin'," a rather obvious but well done story in which a technically black U.S. agent is sent to Germany to pick up a black boy whom the Pentagonners expect to use as a telepathic, clairvoyant spy. From Bob Silverberg, projection of much the same problems into a future where "Black is Beautiful"—but it's a white man's story.

From Poland, "The Ugupu Bird," a delightful little fable of the ridiculous by Slawomir Mrozek. From Czechoslovakia, another fable that reads almost like something out of Hawthorne, "The Lost Face," by Josef Nesvadba. From Russia, "Erem," by Gleb Anfilov, a relatively straightforward story of Man's inhumanity to robots, picked up from Mirra Ginsburg's excellent 1970 anthology of Soviet SF, "The Ultimate Threshold."

Naomi Mitchison, a pretty big name in English letters, is here with "Mary and Joe," a subtle, gentle story of virgin birth in our time. Jerry Farber, in "Gorman," has a biting satire of academic circles only a little way in our future—by all odds the roughest story in the book. Following it, Hayden Howard's "Oil-Mad Bug-Eyed Monsters" is almost an anticlimax—California real estate finagling with an odd, but not concealed, twist.

Until we got a traffic light at the corner, a saying in my urban neighborhood was: "If you can see 'em, it's too late to cross"—and you could see about half a mile. Two stories, back to back, project urban traffic

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into the future. Robert Coover's "A Pedestrian Accident" is the blackest of black comedy, while William Earls's "Traffic Problem"—which takes an executive's viewpoint rather than a traffic victim's—is cynically cruel and all too plausible. With these you might put Gene Wolfe's "Car Sinister," total fantasy in the *Unknown* vein. Ever thought of *breeding* cars?

"Inner space" has been the catchword of speculative fantasy of late, and Thomas Disch's "The Asian Shore" is this anthology's voting delegate from inner space. It is fantastic in that its narrator, a scholar dodging life in Istanbul, finds himself somehow sucked into a change in identity in which he becomes a hapless, hopeless Turkish peasant with a wife and boy, neither of whom he can understand.

The farthest out of the stories in the book is " 'Franz Kafka' by Jorge Luis Borges," by Alvin Greenberg. This is a deadpan, highly scholarly account of the spread in intellectual circles of a new and undissected symbolism, which seems somehow related to the metamorphosis in Kafka's famous fantasy of the man who became an insect, somehow derived from a lost, underground manuscript in hieratic code, attributed to Borges. But the strangeness spills over into the following—and closing—story, the Neville-O'Donnell "Pacem Est," a vignette in a totally insane future condition of war.

Both authors, in a prologue and epilogue, comment on the state of the art in our time. I don't think this is the direction science fiction should take. On the other hand, I don't know what direction speculative fantasy can go. Maybe just sit still and spin.

WORLD'S FAIR, 1992

By Robert Silverberg • Follett Publishing Co., Chicago • 1970 • 248 pp. • $4.95

Follett is a conservative publisher of textbooks and juveniles, so this is not as good a SF juvenile as you would expect from the "new" Silverberg. He should by this time be able to write at least as good a book for teen-agers as Robert Heinlein, and a better one than most of the other practitioners. I am quite willing to believe that the publisher told Bob what they wanted, and he delivered as ordered.

The gimmick is that a U.S. promoter sells the world the idea of celebrating Columbus's five hundredth anniversary with a Columbian Exposition in space, in a world's fair satellite. The economics and logistics are glossed over much more quickly than Silverberg has done since his earliest days, but there's a good if elementary story about Bill Hastings, the high school prize-winner who gets to work for a year in the Martian environmental exhibit . . . where they have a colony of real Old Martians, kidnapped and cooped up in a habitat box. There are accidents,

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there's politicking, there are what seem to these old eyes to be youngsters a lot more believable than Tom Swift ever was . . . and as a bonus, there's a trip to Pluto to pick up some Old Plutonians and Save the Fair.

Ordinary, but quite nice. It's just that others are doing it better . . . and Silverberg could if they'd let him.

DINOSAUR BEACH

By Keith Laumer • Charles Scribner's Sons, New York • 1971 • 186 pp. • $4.95

This book is expanded from the novelette, "The Timesweepers," which was here in Analog back in August, 1969. In it Keith Laumer manages to convert the various time-travel paradoxes and clichés into as complicated a piece of macramé as you'll find in the newest of craft shows.

The basic concept isn't new—a corps of "timesweepers" dedicated to correcting the tangles which clumsy, or scheming, time travelers have wrought in the web of time. Only, it's not that easy, in this book or any Laumer book, for that matter. Because you have another corps of Third Era operatives shuttling through time to undo the damage the Second Era corps create . . . and a Fourth Era cleaning up after the Third . . . and so on, like a Quaker Oats box. The base on Dinosaur Beach, back in the Jurassic, seems to be a crossroads for them all—and weaving in and out of all Eras and all times are the autonomous robots, the Kargs.

To complicate things for Nexx Central agent Ravel, who is lost amidst all this tangle, he also keeps encountering a beauteous female-type fellow-agent who looks just like the girl he left behind in 1936, in the first chapter. To complicate them still more, he blunders into a fracas on a fake pirate ship and gets himself killed, most bloodily . . . while he watches it happen from the sidelines.

Some of the fan critics are probing for deep philosophical significance. Maybe it's there. I read it for fun.

THE ELECTRIC BIBLIOGRAPH, PART I: CLIFFORD D. SIMAK

Compiled by Mark Owings • 13 pp. • mimeographed • Jay Haldeman, 405 Southway, Baltimore, Maryland 21218 • $1.00

This attractively mimeographed bibliography of Clifford Simak's science fiction and related books has been reprinted from the *Journal* of the Washington Science Fiction Association—the same which heroically undertook our recent short story poll. Mark Owings says that the series will be continued with other reprints from the *WSFA Journal*, other fanzines, and the program books of regional conventions, which are doing an excellent job of publishing bibliographies of their professional guests.

The brief introduction on Simak

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and his work is dated Hallowe'en 1970, which presumably indicates the cut-off point. Owings quotes Kingsley Amis's judgment that Simak is "science fiction's poet laureate of the countryside," but prefers a more general theme: "aliens for neighbors." I think they are both right; neighbors are important in the country.

Stories and books are listed alphabetically and chronologically, beginning with the magazine appearance—if any—then continuing with English-language publication in books, and in many cases in foreign-language anthologies. Changes in title—and there have been a good many—are duly noted and cross-referenced.

I can't say how complete it is, but it's an excellent job.

MOONFERNS AND STARSONGS
By Robert Silverberg • Ballantine Books, New York • No. 00278-5-095 • 244 pp. • 95¢

Of all the "old guard" of science-fiction writers, Robert Silverberg has best demonstrated that he can handle the entire spectrum, from conventional to "New Wave," without discarding the ability to communicate ideas, moods, and all the other facets that have set science fiction apart.

The eleven stories in this collection include two award winners. "Nightwings"—the first section of the novel of the same name, about a distant and strange future when Earth's cities are fossil traditions—and "Passengers"—the ugly one about mischievous possession. "A Happy Day in 2381" projects a future which is thoroughly disturbing; it's part of a novel to be published later in the year.

Bob Silverberg hasn't been a very frequent member of the Analog stable, but "To Be Continued" was here in 1956; it's a pleasant, but unimportant, gimmick story about immortals. "After the Myths Went Home" is a sardonic one about our attitudes toward our mythical and half-mythical heroes—and about a time when we have outgrown our myths. "We Know Who We Are" is a quite short fable from the far future, when other men have reached stability and don't want wild factors disturbing their lives.

Stories about "inner space" are supposed to be one of the criteria of the New Wave in speculative fiction. In "The Pleasure of Their Company," Silverberg smoothly hybridizes inner and outer space in a story of a spaceman who thinks he has found a way to protect himself from the loneliness of the space between the worlds, by taking along a company of fascinating companions in computerized similacra. "The Songs of Summer" is a more conventional one, in which a pragmatic human corrupts and destroys an arcadian society. This is "old" Silverberg (1956); it is followed by "A Man of Talent" (1966), in which a famous poet bestows himself on a retarded society.

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The last two stories offer a similar contrast. "Collecting Team" is almost reminiscent of the screwy-animal stories that Stanley Weinbaum and John Campbell wrote back in the '30s . . . but with a difference. It's still a gimmick story with a telegraphed tag line. "Going Down Smooth," on the other hand, is an "inner space" story told by a computer.

Very few writers cover such a range these days. Be glad we have one who does.

STARDREAMER

By "Cordwainer Smith" • Beagle Books, New York • No. 95127 • 185 pp. • 95¢

The late Dr. Paul Linebarger, political scientist, oriental authority, teacher, and in many other ways a distinguished member of "straight" intellectual society, wrote a series of our most memorable science fiction books and stories under the pen name "Cordwainer Smith." Most of them fit into a strange and intricately imagined tapestry of the future, in which men wander through space, breed strange varieties out in the fastnesses, create people who were once animals . . . there is really no end to the imagining that has gone into these stories. Half of the eight stories in this collection fit into the "Instrumentality" series; the ones that do not were hardly worth the trouble of collecting them.

The four Instrumentality stories are spread over much of the series' vast span. In "Think Blue, Count Two" we are in the era of the interstellar sail-ships. In "Under Old Earth," the best of the four, the Lords of the Instrumentality are finding that the worlds they built are going out of their control and even their understanding. "The Crime and the Glory of Commander Suzdal" comes fairly early in the sequence, when men are first becoming acquainted with the stars. "When the People Fell," in which China colonizes Venus by dumping its populace out of the skies in a rain of humanity, is earliest of all.

Readers who don't like Cordwainer Smith complain that this is all moonshine and hogwash . . . but let's look at just one story, "Think Blue, Count Two," for some of the very "hard" ideas the author has quietly brushed into them. The idea of ships propelled by light pressure on gigantic sails isn't new any longer—Poul Anderson, in particular, has used it effectively— and the truism that we use only a fraction of our brain's potential is another oldie. But see what "Smith" has done here. He has suggested that an entire human personality can be impressed on the unused cells of a mouse brain—actually, of a small slice of a mouse brain—and used to create immortal guardians and servants for the sailors of the stars. He has realized that the crews and passengers of these ships must be bred and conditioned for their strange lives. "Think Blue" isn't the haunting story that "The Lady

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Who Sailed the Soul" was—the one in which we first encountered the sailing ships—but it opens horizons that the older story didn't.

My preference for "Under Old Earth" is probably because it does fill in so many empty spots in the tapestry of the weird society of Lords, robots and underpeople developed through the millennia on and in Old Earth. Here Lord Sto Odin, tired of living, goes down into Earth to see for himself, before he dies, how badly the Instrumentality's lovingly constructed society has failed to serve man. The story of what Commander Suzdal did to avert the menace of the Arachosians probably goes a little deeper than it seems. This may tell us something about the origin of the man-and-cat symbiosis that we saw in "The Game of Rat and Dragon." "When the People Fell" is slight and simple—but it says something important about Chinese attitudes that could affect our own futures.

Of the non-Instrumentality stories, "The Good Friends" is quite prosaic and rather flat, perhaps simply because it does deal with a less strange future than the great series. A spacer creates companions out of his hallucinations . . . but was this the forerunner of the mouse-brain guardians in "Think Blue"? "Angerhelm" is just a good story, and the best of the four, with bureaucratic frustration nicely handled. "The Fife of Bodidharma" is a rather routine secret-from-the-past tale, but "Western Science Is So Wonderful" is quite nice, with its highly potent Martian confronting an assortment of our kind.

That Cordwainer Smith never had a hardback book of his own is incredible. Some day somebody will put all the Instrumentality stories together and show us what we have overlooked.

THE YNGLING

by John Dalmas • Pyramid Books, New York • No. T2466 • 224 pp. • 75¢

I have been having too much trouble keeping up with the flood of more or less conventional science fiction to devote any attention to that subgenre which could be called future sword-and-sorcery yarns. These—some good, some ordinary—share the familiar concept of a distant future when civilization has retrograded to a feudal level, or lower, and what was once science has become magic. However, since this story was serialized in Analog in 1969, an exception seems in order.

"The Yngling" has another not too usual feature. From time to time an author will build a future or otherwordly society on the foundation of some period in our own history. Years ago, Dr. Miles J. Breuer refought the American Revolution on the Moon, and Isaac Asimov used the history of the Roman Empire as the model for his "Foundation" stories. Now John Dalmas uses the Middle Ages of Europe as the mold for a Europe of the Twenty-ninth Century.

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My medieval history shelf isn't good enough to tell me whether he is following one particular era closely, or whether he is simply using the general structure of the first millennium, or so, of the Christian era—at a guess, the period around A.D. 1000, when the Viking freebooters were on the move, western Europe was split up into a mosaic of small kingdoms and baronies, the Cumans—or was it a later Mongol Horde?—were pressing in from the steppes, a corrupt Byzantium was on its last legs, and the Mohammedan world was rising. In the Twenty-ninth Century, the political structure is much the same, but there is a web of telepaths to hold it together with the aid of "magical" scientific devices from our nearer future.

Nils Järnhand is a Swedish warrior who has been exiled because of a killing. Seeking his fortune in the South, he soon discovers his own telepathic abilities and comes in contact with the network. They send him to kill an evil Near Eastern telepath, Kazi, who is overrunning the Balkans and eastern Europe, and who has discovered a psionic technique for making himself immortal. Before he succeeds, all Europe is at war and Nils has had to sell himself to his former tribesmen as the reincarnation of a hero of a dynasty of Swedish kings or chieftains of *our* Dark Ages, the Ynglings.

The publisher is labeling the book "sword and sorcery" with brawn and heroism pitted against "evil magic." It isn't that at all. But, for me, the historical parallel interferes with the action. Names from five hundred or a thousand years ago dropped into a world of nearly a thousand years in the future nag at me. Maybe an afternoon in the library is what I need . . .

SF PUBLISHED IN 1970

By Joanne Burger • The Author, 55 Blue Bonnet Ct., Lake Jackson, Texas 77566 • Mimeographed • 48 pp. • 75¢

Joanne Burger's annual listing of hardback and paperback science fiction and fantasy is growing more comprehensive and more and more of an essential tool. As always, I am appalled at the number of books, published during the year, that I never even heard of. She asks for additions and corrections, and means it; she has sent out addenda to some of her previous compilations.

This is a tripartite listing; more accurately, a bipartite—first by author, then by title—followed by an appendix on series—e.g. Doc Savage, Retief, Flandry. The most complete information is given under the initial author listing.

The attractive cover by Doug Potter is professionally silk-screened by Martha and Johnny Moore. (I apologize for not crediting the cover work on earlier issues.)

Seems to me any collector should have it, and any library with a SF collection should place a standing order.

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EDITORIAL
continued from page 7

But what would be the price for this desirable result?

For one thing, you'd probably have to put your car through an exhaust emissions check every time you stopped for gas. Rather expensive and sophisticated equipment would be set up at each gas station to measure the pollutants coming out of your car's exhaust pipe. Other equipment would be on hand—much of it very conventional—to adjust the tuning of the car's engine so that exhaust emissions are within tolerable levels. The equipment used for measuring emissions would be sophisticated, as we said, but it would be simple to operate. Part of its sophistication would be in the "human engineering" necessary to make the equipment usable by gas station attendants, with relatively little special training. The military has a long history of procuring sophisticated gear that is operated by ordinary GI's, with rather minimal training. Of course, the technicians who maintain the equipment are rather highly specialized people. In the case of the gas station pollution-monitoring gear, there would probably be special technicians covering the gas stations on a regular rotation basis, to check the equipment and make sure everything is operating properly. In the military, this is called IRAN: Inspect and Repair As Necessary.

Such a system of monitoring and engine adjustments, if mandatory and vigorously pursued, could cut automobile pollution down to very low levels. It would also be necessary, in the long run, to get Detroit to produce low-emission engines. The Federal Government is already pursuing this. Federal emission standards for 1975 are low enough to cause loud wails of complaint from Detroit, despite the fact that automotive industry witnesses told Congress many years ago that such engines could be produced "within five years of a go-ahead." Thus Detroit has been hoisted on its own petard.

But to get back to our hypothetical situation. Given clear political sailing, the engineers could also drastically reduce the pollutants emitted by factories and electrical power plants. The price would be a ten or twenty percent hike in the electricity bills we pay. The difference between the ten percent and the twenty is mainly a matter of how efficient the antipollution equipment will be. There exists today a whole complex of smoke scrubbers, soot catchers, cooling towers and other devices to clean smokestack gases and eliminate thermal pollution of water. They are expensive, both in terms of capital cost and in cutting down the operating efficiency of the plant to which they're attached. But, if you want to dramatically reduce the pollution, it can be done. For a price.

Now look at where we are politi-

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cally. No political organization in this nation has the authority to walk into every factory, power plant and gas station with expensive antipollution gear and force every citizen to pay the price for pollution control. In fact, such political power could easily become a problem in itself—what starts out as antipollution could end as antifreedom.

Much the same situation can be found in most of the other Burning Issues of our times. The technology is there, ready and willing to tackle the problem. But the political setup is not ready. High-speed trains go through many cities, towns, counties, states—each with its own set of politicians, union leaders, landowners, and cantankerous citizens. Urban renewal has become a political football in most cities. Education is at the mercy of thousands of individual school boards that are more interested in keeping costs down than improving the quality of the children's education. Everybody wants to improve the quality of life, but nobody wants to pay for it.

And meanwhile the scientists and engineers are facing shrinking budgets, hostile attitudes, and that basic question: What good is it?

The simple answer to that question is: As good as you want to make it.

* * * * *

Last spring Kelly Freas was assigned by *Analog* to do a series of sketches of the NASA facilities at Cape Kennedy. He thoroughly enjoyed doing the job, but came away deeply concerned about the future of the space program, convinced that the situation was nothing less than desperate: the rhetoric couldn't contradict the obvious fact that schedules were being wound down, missions scratched for lack of funds, personnel sharply cut—all the signs of imminent collapse.

Since we science-fiction types seem to be the only ones who appreciate the real importance of the space program, as opposed to its political and economic aspects, Kelly decided we would have to be the ones to do whatever could be done.

He realized that his best contribution would be in the field he knew best—the illustration of ideas—and shortly came up with designs for a series of posters. He then asked the advice of a friend, Ben Grey, Graphics Coordinator of the City of Chesapeake School System. The Chesapeake schools authorized its graphics students to produce a series of six posters, to be placed in all the schools in the system. The kids did the photography, plates and printing—from Kelly's originals.

One of the posters is reproduced here. The black-and-white reproduction hardly does justice to the original. In full, fluorescent color the posters are truly magnificent.

The poster sets are available directly from Kelly. Any requests for information about them sent to *Analog* will be forwarded to Kelly immediately. ■ THE EDITOR

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